RCRA Facility Investigation
Soil Interim Measures Project
Completion Report
Atlantic Research Corporation Facility
Gainesville, Virginia

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Acronyms and Abbreviations

ARC	Atlantic Research Corporation
bgs	below ground surface
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CMS	Corrective Measures Study
COPECs	Chemicals of Potential Environmental Concern
CSM	Conceptual Site Model
DCA	Dichloroethane
DCE	Dichloroethene
E&S	Erosion and Sedimentation
EC	Engineering Control
EQ	The Environmental Quality Company
GPR	Ground Penetrating Radar
IC	Institutional Control
HI	Hazard Index
HQ	Hazard Quotient
IM	Interim Measures
MD	Munitions Debris
MDAS	Material Documented as Safe
MEC	Munitions and Explosives of Concern
MPPEH	Material Potentially Presenting an Explosive Hazard
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
RCRA	Resource Conservation and Recovery Act
RDX	1,3,5-trinitro-1,3,5-triazinane
RECO	Aqua Clean Environmental of Virginia LLC d/b/a Reco Biotechnology
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
RTA	Rocket Test Area
SRA	Soil Removal Area
SRFI	Supplemental RCRA Facility Investigation
SVOC	Semi Volatile Organic Compound

TCA	Trichloroethane
TCE	Trichloroethene
TP	Test Pit
TTU	Thermal Treatment Unit
USEPA	United States Environmental Protection Agency
VADEQ	Virginia Department of Environmental Quality
VOC	Volatile Organic Compound

Executive Summary

Atlantic Research Corporation (ARC) has completed soil interim measures (IM) activities at its former manufacturing and testing facility located on leased property in Gainesville, Virginia. The soil IM activities were completed consistent with the *Soil Interim Measures Work Plan* (*Soil IM Work Plan*; Geosyntec 2011) approved by the United States Environmental Protection Agency (USEPA) on April 8, 2011.

ARC initiated the soil IM program in a pro-active fashion so that potentially significant soil exposure risks identified from data collected as part of the Supplemental Resource Conservation and Recovery Act (RCRA) facility investigation (SRFI) would be mitigated prior to ARC's terminating its lease and returning the leasehold to the site owner, Ganiesville Associates, LLC. The SRFI was completed during the period of 2002 to 2009, with those findings documented in the Draft *Final SRFI Report* (Geosyntec 2009) as supplemented by the *Addendum to the Draft Final SRFI Report* (Geosyntec 2012b). The main findings of the SRFI relevant to soil IM activities are:

- Constituents present in soil at concentrations that are likely to warrant corrective measures include PCBs, perchlorate, RDX (1,3,5-trinitro-1,3,5-triazinane), SVOCs (primarily diesel constituents in soil only) and VOCs including tetrachloroethene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethene (1,1-DCE), and 1,1-dichloroethane (1,1-DCA).
- Energetic constituents including perchlorate represent the majority of constituents in environmental media on the Site on a mass basis (i.e., highest concentrations and largest estimated volumes impacted).
- Four areas of the Site were found to contain hazardous and non-hazardous buried debris.

In identifying areas where soil IMs were appropriate, ARC relied upon the data and information gathered during the SRFI, and considered the USEPA's corrective action program goal to expedite risk reduction by emphasizing early implementation of interim actions to control or minimize ongoing threats to human health or the environment. Further, ARC recognized that these interim actions should be compatible with, or a component of, the final remedy for the Site. To achieve this objective, the 2011 *Soil IM Work Plan* provided an implementation plan for timely removal of buried debris and the removal of impacted soil in order to achieve acceptable soil exposure risks for current and future industrial/commercial land use.

The IM addressed areas that would likely require remediation by removal/treatment rather than using institutional controls (ICs)/engineering controls (ECs). As such, soil remediation included the removal of potentially hazardous buried debris and/or removal to mitigate unacceptable soil exposure risks (i.e., cumulative cancer risks greater than 10^{-4} and/or noncancer HIs greater than 1 under a commercial/industrial land use scenario).

Initially seven areas were identified in the *Soil IM Work Plan* as potentially requiring soil removal – four areas were identified due to the presence of potentially hazardous buried debris and three areas were identified as having soil concentrations that may result in potentially unacceptable risks under commercial/industrial land use. An additional seven areas were

identified as having concentrations that could warrant soil removal but each area was deemed to have insufficient data to adequately assess potential risks (i.e., typically only one to three borings within a half-acre area, with the location having the highest concentration not bounded in all lateral and vertical directions). Accordingly, ARC completed additional sampling efforts to gather the information needed to determine if the Soil IM program should be expanded.

Prior to implementing the soil removal for the identified soil IM areas, pre-removal sampling was conducted to: (1) more precisely delineate and reassess risks in IM areas considered to have insufficient data to determine the need for remediation or the limits of excavation; and (2) refine the excavation limits. A second stage of soil sampling was implemented to address data gaps that still remained after the first stage of soil sampling, and to complete pre-excavation waste characterization for non-debris soil removal areas (SRAs). The results of this pre-removal sampling program are presented in the *Soil Interim Measures Interim (IM) Report* (*Soil IM Interim Report;* Geosyntec 2012). As discussed in the *Soil IM Interim Report*, two additional non-debris areas were identified subsequent to the submittal of the *Soil IM Work Plan*.

Of the identified soil IM areas, six non-debris areas were eliminated from further assessment since the concentrations in soils in these areas were determined to not pose an unacceptable risk under commercial/industrial land use. Soil interim measures consisting of soil excavation and off-site disposal were performed at the remaining identified soil IM areas. For non-debris areas, soil was excavated to the limits necessary (both vertically and laterally) to reduce soil exposure risks to acceptable levels. For debris areas, the limits of excavation were determined based on the extent of the buried debris encountered in the area, with post-excavation soil sampling conducted to confirm that concentrations of hazardous constituents in soil at the limits of the excavation did not post an unacceptable risk under commercial/industrial land use.

The soil IM program was implemented during the period of March 2012 to May 2013. The total quantity of soil and debris removed and disposed of off-site was approximately 30,000 tons. Approximately 25% of excavated material was disposed of as hazardous/regulated waste and 75% was disposed as non-hazardous/non-regulated waste. Approximately 11 tons of energetic materials were disposed off-site, including 155 items of Munitions and Explosives of Concern (MEC), as well as un-used propellant that were screened and segregated from soil IM excavations. Approximately 6 tons of scrap resulting from the demilitarization of Munitions Debris (MD) including 2,984 items of MD generated by soil IM excavation activities and building cleanout activities along with 173 items of MD generated by earlier RCRA closure work were disposed off-site. Following excavation, each excavated area was backfilled using soils from on-site borrow areas approved by USEPA on May 30, 2012, graded and seeded. In addition, the limits of excavation were surveyed to provide documentation of the extent of removal.

Following submittal of the *Soil IM Interim Report*, additional areas of soils investigation were also explored. These areas were identified based upon electromagnetic and ground penetrating radar (GPR) survey results. Areas exhibiting high electromagnetic readings were designated for further assessment by test pit (TP) investigation. The investigation, and if warranted, removal of hazardous materials from these areas was conducted consistent with the procedures utilized in investigating the soil IM debris areas. Soil excavated as part of these test pit investigations was staged adjacent to the test pit area for potential use as backfill. Sampling of the test pit

excavations and staged excavated soil was performed consistent with debris area post-excavation sampling protocols detailed in the *Soil IM Interim Report*. If analytical testing determined that the excavated soil was not suitable for backfill, then the excavated soil was disposed at an appropriate permitted off-site facility.

Following completion of the soil excavation activities, sampling data representing the post-removal conditions within each of the soil IM areas were used to confirm that the soil IM program achieved acceptable soil exposure risks for industrial/commercial land use. The approach for verifying the post-removal human health risks was consistent with the approach presented in the approved *Soil IM Work Plan*.

As documented in this report, ARC achieved the objective of the soil IM program – all on-site soils posing a potentially unacceptable exposure risk for continued commercial/industrial land use have been removed. Further, as documented in the November 2012 *RCRA Facility Investigation Baseline Risk Assessment* (ENVIRON 2012), which reassessed potential human health risks based on all soil data outside of the remediated soil IM areas, all current and future potential exposures for on- and off-site receptors to soil under commercial/industrial use are at or below USEPA's cumulative cancer risk and noncancer HI limits of 10^{-4} and 1, respectively. The baseline risk assessment did identify 117 soil sampling locations that potentially pose an unacceptable risk if the land use were to change in the future; specifically, the baseline risk assessment evaluated potential soil exposures associated with residential land use. As shown on Figure ES-1, under residential land use, an estimated eight acres of the site would warrant further evaluation for corrective measures (e.g., remediation, and/or ICs/ECs). These areas are to be further evaluated in the corrective measures study to be prepared by ARC.

1. Introduction

Atlantic Research Corporation (ARC) has completed soil interim measures (IM) activities at its 420 acre leased facility located in Gainesville, Virginia (the Site; see Figure 1-1). The soil IM activities were completed in accordance with the *Soil Interim Measures Work Plan* (*Soil IM Work Plan*; Geosyntec 2011) approved by USEPA on April 8, 2011. ARC initiated the soil IM program to address potentially significant soil exposure risks prior to ARC's terminating its lease and permanently exiting the site. Specifically, soils that potentially posed an unacceptable risk to current industrial/commercial land use receptors were investigated, documented, and removed by environmental consultants and contractors to ARC. In addition, areas where debris was buried in pits, trenches, and other below ground areas on the property were investigated; excavated materials were screened for potentially hazardous material and Material Potentially Presenting an Explosive Hazard (MPPEH), and this material was removed in accordance with the *Soil IM Work Plan.* As documented in this Soil IM Project Completion Report, following completion of this work, no additional soil removal activities are necessary to mitigate potentially unacceptable risks under current and future industrial/commercial land use. In addition, as presented in the November 2012 *RCRA Facility Investigation Baseline Risk Assessment* (ENVIRON 2012), with the exception of approximately eight acres of the 420 acre site, soils also meet acceptable risk levels for unrestricted residential use; with the implementation of certain engineering and institutional controls within those eight acres, the entire site could be re-developed for residential use with respect to soils.

1.1 Report Organization

This report is organized as follows:

- Section 2 presents background information relevant to soil IM activities including an overview of the Supplemental Resource Conservation and Recovery Act (RCRA) facility investigation (SRFI) findings; the rational and objectives of the soil IM program; the strategy and approach used to identify areas for interim measures; the strategy and approach used to identify the extent of IM excavations; the approach for assessing on-site soils for use as backfill; and details regarding the nature and purpose of supplemental test pit investigations conducted during the implementation of the soil IM program.
- Section 3 describes soil IM implementation activities. This section provides specific information regarding each soil IM area, including (1) pre-excavation sampling and human health risk estimates; (2) the extent of excavation; (3) results of post-excavation sampling (if performed); (4) a summary of post-remediation risk estimates; (5) details regarding restoration activities; and (6) waste characterization for excavated materials.
- Section 4 provides a summary of an overall assessment of the completed soil IM activities relative to the objectives of the program.
- Section 5 provides a listing of references cited in the report.

2. Overview of Soil IM Program

This section provides background information relevant to soil IM activities including an overview of the SRFI findings (Section 2.1); the rationale and objectives of the soil IM program (Section 2.2); the strategy and approach used to identify areas for interim measures (Section 2.3); the strategy and approach used to identify the extent of IM excavations and soils suitable for use as backfill (Section 2.4); the characterization of on-site soil from borrow areas to be used as backfill (Section 2.5); details regarding the supplemental test pit investigation program initiated during the implementation of the soil IM program to further define the extent and nature of buried debris areas (Section 2.6); characterization of potential risks associated with soil exposures after the soil IMs were completed (Section 2.7); and, a summary of the validation conducted as part of the soil IM program (Section 2.8).

2.1 Overview of the SRFI Findings

The SRFI was completed at the Site from 2002 to 2009, with the findings documented in the Draft *Final SRFI Report* (Geosyntec 2009), as supplemented by the *Addendum to the Draft Final SRFI Report* (Geosyntec 2012b), herein referred to as the SRFI Report/Addendum. The SRFI was implemented with the following objectives:

i) Confirm and refine the Conceptual Site Model (CSM) to an extent sufficient to conduct the Baseline Risk Assessment (BRA) and a supplemental Corrective Measures Study (CMS) for the Site, including the identification of all areas of concern and necessary delineation of constituents in shallow and deep groundwater, surface water, sediment, and/or soil associated with these areas of concern.

ii) Define potential Site decommissioning considerations (including identification of any additional areas of concern) associated with Site infrastructure (e.g., sumps, leach-fields, building foundations, tanks, etc.) that may be impacted with hazardous waste or constituents or that may otherwise warrant special handling during potential future Site redevelopment activities.

The specific findings of the SRFI are detailed in the *SRFI Report/Addendum* (Geosyntec 2009, 2012b) and thus are not repeated here. A brief summary of the main findings relevant to soil IM activities are summarized below:

- Constituents present in soil at concentrations that are likely to warrant corrective measures include polychlorinated biphenyls (PCBs), perchlorate, RDX (1,3,5-trinitro-1,3,5-triazinane), semi-volatile compounds (SVOCs) (primarily diesel constituents in soil only) and volatile organic compounds (VOCs) including tetrachloroethene (PCE), 1,1,1- trichloroethane (1,1,1-TCA), 1,1-dichloroethene (1,1-DCE), and 1,1-dichloroethane (1,1- DCA).
- Energetic constituents including perchlorate represent the majority of constituents in environmental media on Site on a mass basis (i.e., highest concentrations and largest estimated volumes impacted).
- Four areas of the Site were found during the SRFI to contain buried debris (i.e., soil removal areas [SRAs] 1, 2, 3, and 7).

2.2 Soil Interim Measures Program Objectives

ARC initiated the soil IM program so that potentially significant soil exposure risks and other hazards, such as buried debris, would be mitigated soon after the completion of the SRFI. In identifying areas where soil IMs were appropriate, ARC relied upon the data and information provided in the *SRFI Report/Addendum*, the 2011 *Soil IM Work Plan*, and considered the USEPA's goal to expedite risk reduction by emphasizing early implementation of interim actions to control or minimize ongoing threats to human health or the environment (USEPA 1996). Further, ARC recognized that these interim actions should be compatible with, or a component of, the final remedy for the Site. To achieve this objective, the 2011 *Soil IM Work Plan* 1) provided an implementation plan for removal of impacted soil on the property that were identified as posing a potentially unacceptable risk to current and future industrial/commercial land use receptors. It also provided the actions necessary to remove and properly dispose of potentially hazardous buried debris on the property.

Specific objectives of the soil IM program included the following:

- Identifying areas that have potentially unacceptable risk for industrial/commercial land use;
- Defining areas that would require soil and/or debris removal;
- Prioritizing the areas where soil removal would be completed into two stages (Stage 1 and Stage 2). This prioritization allowed ARC to expedite the soil IM process, generally targeting remediation of areas containing debris in the first phase and remediation of areas without debris in the second phase; and
- Excavating and disposing of impacted soil and/or debris at each identified soil removal area, followed by restoration activities (backfill, re-grading and seeding).

2.3 Identification of Interim Measure Soil Removal Areas

In developing an approach for defining the scope of appropriate IMs, ARC considered the following information:

- The existing condition of each area identified as potentially warranting soil IM;
- The findings identified in the *SRFI Report/Addendum*;
- The type of units and areas to be addressed;
- The exposure pathways associated with potential releases of hazardous constituents from these areas; and
- The current and reasonably anticipated future land use at and surrounding the Site.

In addition, the scoping of the soil IM incorporated the fundamental aspects of USEPA corrective action program policy as detailed in the *Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities; Proposed Rule* (USEPA 1996) and *Post-Closure Permit Requirements and Closure Process; Final Rule* (USEPA 1998). In particular, USEPA's Corrective Action implementation principles include the following:

1. Program implementation should focus on results, taking into consideration: (*i*) site-specific circumstances that warrant flexibility in implementing the corrective action process, developing cleanup objectives and selecting appropriate site-specific corrective measures; (*ii*) innovative site characterization techniques to expedite investigations; (*iii*) existing data pertinent to understanding the site conditions to reduce SRFI data collection needs; and (*iv*) streamlining initiatives, including presumptive remedy guidance developed under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) program to expedite investigations and cleanups.
2. Corrective Action activities should be phased to focus on areas or pathways of highest concern.
3. Corrective Action decisions should be based on a realistic assessment of human health and ecological risk, taking into account current and reasonably expected future land use on-Site and off-Site, including contamination from off-site unrelated sources that could prevent achieving risk-based cleanup goals solely by addressing site-related releases. To identify potentially significant risks, the cumulative cancer risk and HI estimates for each receptor population should be compared with USEPA's cancer risk limit of 10^{-4} and hazard index (HI) limit of 1, respectively, for determining whether a site warrants corrective measures (61 Federal Register 19432, May 1, 1996; USEPA 1991).

In identifying areas where soil IMs were appropriate, ARC specifically considered the 1996 *Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities*, in which USEPA stated that one of the primary implementation strategies for the Corrective Action program is to expedite risk reduction by emphasizing early implementation of interim actions to control or minimize ongoing threats to human health or the environment. Further, USEPA desires such interim actions to be compatible with, or be a component of, the final remedy. Although existing conditions at the Site currently do not pose an imminent and substantial threat, or any ongoing threat, as discussed above, ARC believed that it would be beneficial to initiate soil IM activities that would be consistent with the ultimate and anticipated corrective measures for the Site.

Therefore, removal of soil and potentially hazardous buried debris at identified areas was conducted to mitigate unacceptable soil exposure risks (i.e., cumulative cancer risks greater than 10^{-4} and/or noncancer HIs greater than 1) under a commercial/industrial land use scenario. As presented in the *Soil IM Work Plan* approved by USEPA on April 8, 2011 and the *Soil Interim Measures (IM) Interim Report* (*Soil IM Interim Report*; Geosyntec 2012a), areas that were considered for IMs were identified using the following approach:

<u>Non-Debris Areas</u>

1. Existing soil characterization data were screened against USEPA's Industrial Regional Screening Levels (RSLs)[1] adjusted to a target cancer risk of 10^{-5} and hazard quotient (HQ) of 0.1 in order to identify the chemicals of potential environmental concern (COPECs). The

[1] For chemicals that were detected in soil which do not have a RSL but for which toxicity and physical/chemical information is available, risk-based screening levels were calculated using the same methods used by USEPA to calculate the RSLs.

non-debris Soil IM Areas identified based upon this screening evaluation are presented on Figure 2-1. For soil boring locations within the Soil IM Areas determined to be inadequately delineated (i.e., sampling locations with lower concentrations in lateral and vertical directions), additional sampling was conducted as outlined in Section 3.2 of the *Soil IM Work Plan* to ensure that the soil impacts were adequately characterized to facilitate a conservative evaluation of exposure risks and definition of remediation limits.

2. For each Soil IM Area, the upper-bound cumulative cancer risk and noncancer HI were calculated by scaling from the adjusted industrial RSLs using the highest concentrations of all chemicals detected in the area from any boring at any depth. These highly conservative risk estimates were then compared to a cumulative soil risk threshold of 10^{-4} and noncancer HI of 1 (61 FR 19432, May 1, 1996; USEPA April 22, 1991) to identify Soil IM Areas which exhibited concentrations which could have the potential to pose an unacceptable risk to workers under commercial/industrial land use. The upper-bound cumulative cancer risk and HI estimates for each Soil IM Area are presented on Table A1 of the *Soil Interim Measures (IM) Interim Report* (*Soil IM Interim Report*; Geosyntec 2012a).
3. Because future industrial/commercial land use could involve large scale construction as part of redevelopment activities, cumulative cancer risk and noncancer HI were also estimated for hypothetical construction workers exposures. The construction worker exposure scenario assumes exposure to soil via direct contact and inhalation during excavation activities associated with a one-year site redevelopment project. The assumptions and methodology used to calculate the risk estimates for the construction worker exposure scenario are provided in Attachment A of the *Soil IM Interim Report*. The upper-bound cumulative cancer risk and HI estimates for each Soil IM Area are presented on Table A1 of the *Soil IM Interim Report*.

Buried Debris Areas

1. As presented in Section 3.1 of the *Soil IM Work Plan*, four areas containing buried debris were identified in the SRFI (SRAs 1, 2, 3, and 7). Locations of these areas are presented on Figure 2-1 and additional details for these areas are provided in Appendix D of the *Soil IM Work Plan*.

2.4 Determination of Excavation Limits

Prior to implementing the soil removal for the identified soil IM areas, pre-removal sampling was conducted to: (i) more precisely delineate and reassess risks in IM areas considered to have insufficient data to determine the need for remediation or the limits of excavation; and (ii) refine the excavation limits. A second stage of soil sampling was implemented to address any data gaps that still remained after Stage 1 sampling, and to complete pre-excavation waste characterization for non-debris SRAs. Results of the Stage 1 and 2 sampling events were provided to USEPA in the *Soil IM Interim Report* (Geosyntec 2012a).

Non-Debris Soil IM Areas

As noted above, when soil boring locations within the Soil IM Areas were determined to be sufficiently delineated (i.e., sampling locations with lower concentrations in lateral and vertical directions), additional sampling was conducted as outlined in Section 3.2 of the *Soil IM Work*

Plan. This was done to ensure that the soil impacts were adequately characterized to facilitate a conservative evaluation of exposure risks and determination of remediation limits.

Where warranted, defining the extent of potential excavation was based upon an iterative process that involved collection of samples followed by the estimation of post excavation RME risks under commercial/industrial land use. The limits of excavation necessary to reduce risks to acceptable levels were evaluated and the areas requiring removal were confirmed both vertically and laterally. More specifically, for non-debris areas the following process was used to determine the need for and extent of soil IM excavation:

1. For each non-debris Soil IM Area identified as having a pre-excavation upper-bound site-related cumulative cancer risk or noncancer HI in excess of USEPA's acceptable risk limits for commercial/industrial receptors, the chemicals contributing most significantly to the cumulative cancer and/or noncancer risk estimates were identified. If the lateral and vertical distribution of these chemicals in the area was determined to be adequately characterized, a more representative exposure concentration was calculated (i.e., 95% UCLs on the mean concentration). The 95% UCLs on the mean were calculated using the maximum detected concentration at each sampling location regardless of sample depth or the maximum analytical limit if the chemical was not detected at that location. These refined estimates represent RME risks.
2. Soil IM Areas with pre-excavation upper-bound or RME risk estimates for commercial/industrial receptors below USEPA's acceptable risk levels were not evaluated further as corrective action in these areas would not be required to achieve acceptable risk levels for commercial/industrial land use.
3. For non-debris Soil IM Areas exhibiting pre-excavation upper-bound or RME risk estimates above USEPA acceptable risk limits, the lateral and vertical limits of soil excavation needed to achieve acceptable risk for commercial/industrial receptors was estimated by simulating the soil removal process by iteratively removing samples exhibiting the highest concentration of COPECs from the evaluation until the estimated cumulative cancer and noncancer risks were reduced to within acceptable levels. These results were used to define the final soil excavation extents for each non-debris Soil IM Area; i.e., the sample locations delineating the locations of samples removed from the evaluation were used to define the limits or soil excavation.

Section 3 of this Report presents the results of this analysis for each Soil IM Area. The *Soil IM Interim Report* provides more detail regarding the sampling and analysis performed to determine the excavation extents for each SRA necessary to achieve acceptable commercial/industrial risks.

Potential Buried Debris Areas

As described in the *Soil IM Work Plan*, samples were initially collected around the anticipated extent of the impacted area in buried debris areas based on the footprint of the area derived from geophysical survey results and/or test-pitting, to provide lateral refinement of the potential excavation extents. Vertical samples were then collected at 2-ft intervals to 2 ft below the maximum depth of debris encountered during test pitting or to bedrock, whichever was

encountered first. Samples were analyzed for the full suite of constituents of potential concern (including perchlorate, SVOCs, VOCs, metals, PCBs and nitroaromatics). In cases where the initial samples failed to identify the lateral extent of soil having potentially unacceptable risks, additional samples were collected during supplemental stages of sampling. Sampling from within the extent of the geophysical anomalies was not completed prior to excavation to avoid unsafe drilling through unknown and potentially energetic debris. In the end, the excavation of the buried debris areas extended to the perimeter established by the nearest sample location within acceptable risk levels and/or debris extent. Confirmatory samples were collected from the side walls and base of the excavation below the removed debris, if not excavated to bedrock, to confirm that remaining concentrations would not present potentially unacceptable risks.

2.5 Characterization of On-Site Soil Borrow Areas for Backfill

As described in Section 3.2.2 of the *Soil IM Work Plan*, it was proposed that the soil IM excavations be backfilled with soil obtained from on-site borrow areas, such as berms, to the extent possible. Berms surrounding Buildings 7, 28, 32, 33, 34, 37, 53, 97, and in the Rocket Test Area (RTA) were considered potential candidates for borrow material because concentrations of constituents of concern in the soil in the vicinity of these buildings were low or not detected, and the buildings had limited use and/or waste generation activities (e.g., primarily storage of inert materials only).

As described in Section 4 of the *Soil IM Interim Report*, samples were collected from the eight berms and a risk-based analysis was performed to verify that the berm material could be used to backfill the excavations. The results of this assessment were presented in Section 4 of the *Soil IM Interim Report*. Ultimately, soil from all of these borrow sources was proposed for use as backfill with the exception of soil from the Building 33 berm (Geosyntec 2012a).

As part of the backfilling operations completed in 2012, soils from Borrow Areas 7, 28, 37 and the RTA Borrow Area were used. As each borrow area's material was exhausted, the area was graded in preparation for restoration. Use of soils from Borrow Area 53 was initiated in 2012 and continued into 2013. Prior to demobilization by the Soil IM Contractor, Shaw Environmental, Borrow Areas 7, 28, 37, the RTA, and the exposed soil in Borrow Area 53 were hydroseeded.

2.6 Supplemental Test Pit Investigations

Following submittal of the *Soil IM Interim Report* in March 2012, additional areas of the Site were explored. These areas were identified based upon electromagnetic and ground penetrating radar (GPR) survey results and through detailed analysis of historical aerial photographs and other available historical documents by Geosyntec. Areas exhibiting high electromagnetic readings were designated for further assessment by test pit (TP) investigation. The investigation, and if warranted, removal of hazardous materials from these areas was conducted consistent with the procedures utilized in investigating the soil IM debris areas. Soil excavated as part of these test pit investigations was staged adjacent to the test pit area for potential use as backfill. Sampling of the test pit excavations and staged excavated soil was performed consistent with debris area post-excavation sampling detailed in the *Soil IM Interim Report*. If it was determined that the excavated soil piles were not suitable for backfill, then the excavated soil was disposed off-site in accordance with current waste transportation and

disposal regulations. Section 3.6 of this Report provides additional detail regarding the individual test pit investigations and the analyses performed to determine whether further excavation was warranted in each area and, if not, whether excavated and staged test pit soil could be placed back in the respective test pits or whether it warranted off-site disposal.

2.7 Post Soil IM Risk Characterization

Following completion of the soil excavation activities, the post-IM risks were evaluated based on the data representative of the soils remaining in each area to confirm that the soil IM program objective had been achieved. These post-IM soil risk estimates were calculated consistent with the approach used to identify areas for the IM program; i.e., risks associated with commercial/industrial land use were estimated by scaling from the USEPA's industrial RSLs and hypothetical construction worker risks were estimated as described in Section 2.3.

2.8 Data Validation

The laboratory reports and validation documents for the soil data collected after the submittal of the *Soil IM Interim Report* are included in Appendix A and Appendix B, respectively.

3. Soil Interim Measures Implementation

Section 3.1 describes soil IM areas that were identified during the preparation and subsequent implementation of the *Soil IM Work Plan*. Section 3.2 describes the soil IM implementation activities. Section 3.3 provides a summary of the completed IMs for non-debris areas. Section 3.4 provides a summary of the completed IMs for surface debris areas. Section 3.5 provides a summary of the completed IMs for buried debris areas. Section 3.6 provides the specifics for each test pit investigation area. Section 3.7 provides the specifics for waste characterization of the excavated soil.

To plan and implement the soil IM program, ARC contracted with the following environmental consulting firms and remediation contractors:

- TRC Environmental – corrective action program manager
- Geosyntec – design and oversight of soil IM program
- ENVIRON – human health risk assessment and design support
- Shaw Environmental – remediation contractor

3.1 Pre-Removal Assessment of Soil IM Areas

Initially seven areas were identified in the *Soil IM Work Plan* as potentially requiring soil removal – four areas were identified due to the presence of potentially hazardous buried debris and three areas were identified as having soil concentrations that may result in potentially unacceptable risks under commercial/industrial land use. An additional seven areas were identified as having concentrations that could warrant soil removal but each area was deemed to have insufficient data to adequately assess potential risks (i.e., typically only one to three borings within a 0.5 acre area, with the location having the highest concentration not bounded in all lateral and vertical directions). As discussed in the *Soil IM Interim Report*, two additional non-debris areas, SRA 10 and SRA 11, were identified subsequent to the submittal of the *Soil IM Work Plan*.

Of these identified areas, six non-debris areas were eliminated from further assessment based upon an evaluation of the pre-excavation RME risks estimates, as outlined in Section 2.3 and Section 2.4. These six areas were IM-2 (7800-152 Area), IM-3 (6450-2000 Area), IM-9 (3700-33 Area), IM-10 (3800-46 Area), SRA 10, and SRA 6 (South). The pre-excavation cumulative cancer and HI risk estimates for each non-debris soil IM area are presented on Table 3-1; these risk estimates are the same as those presented on Table A2 of the *Soil IM Interim Report* except that pre-excavation results are now included for SRA 10 and SRA 11 which were identified subsequent to the submittal of the *Soil IM Work Plan.*

As shown on Table 3-1, six non-debris soil IM areas were identified as warranting excavation in order to achieve acceptable soil exposure risks for commercial/industrial land use. These six areas are: SRA 11 (B22AEC-1S Area), SRA 4, SRA 5, SRA 6 (North), SRA 8 (SR-40B Area), and SRA 9 (GPBG-02 Area). Note that soil excavation was also conducted during the implementation of the soil IM program in SRA10 to address the presence of perchlorate beneath Building 22 following building demolition in this area.

The pre-excavation results for each of the non-debris soil IM areas are discussed in more detail in Section 3.3.

3.2 Post Removal Assessment of Soil IM Areas

As described in Section 2.4, following completion of the soil excavation activities, the soil sampling data characterizing the post-soil removal conditions in each area were assembled and the cumulative human health risks were recalculated. Table 3-2 provides the area-specific upper-bound site-related cumulative cancer risk and noncancer HI estimates for each soil IM area (both non-debris areas and debris areas). The results on Table 3-2 are based upon the use of maximum detected concentrations from any soil sampling locations within each soil IM area.

For those locations exhibiting post-excavation upper-bound risk estimates for commercial/industrial soil exposures above USEPA risk limits, refined risk estimates were calculated using a 95% UCL on the mean soil concentration. Consistent with the USEPA approved *Soil IM Work Plan* and USEPA guidance on calculating RME exposure concentrations (USEPA 1992), the refined exposure concentrations were estimated by considering the soil data within a square half-acre area around the soil sample location with the potentially unacceptable risk. These refined risk estimates represent RME risks. The 95% UCLs on the mean were calculated using the maximum detected concentration at each sample location (regardless of depth) or the maximum analytical limit if the chemical was not detected at a given location. The refined risk estimates for routine worker exposure to soil are presented on Table 3-3.

Each non-debris soil IM area is presented on Figures 3-1A through 3-1I. Each surface debris area soil IM area is presented on Figures 3-2A through 3-2C. Each buried debris soil IM area is presented on Figures 3-3A through Figures 3-3D. These figures present the sampling locations and final excavation extents (if excavation was conducted) for each non-debris and buried debris area, as well the location of test pit areas investigated in the vicinity of the buried debris soil IM areas.

3.3 Summary of Completed Non-Debris Area Soil IM Activities

Site mobilization and installation of temporary facilities to support soil IM excavation began in early March 2012. Site roadways were improved to support heavy equipment and truck traffic. Erosion and sedimentation (E&S) controls[2] were installed at planned borrow areas and around the staging/screening area. Fractionating tanks were mobilized to the Site to contain any water that accumulated within the excavation areas or was generated by decontamination activities for subsequent treatment.

For each non-debris and debris IM area warranting excavation, the following tasks were completed prior to initiating excavation:

- Surveyor mark-out for location of E&S controls, limits of disturbance, and excavation area boundaries;

[2] All soil erosion and sedimentation controls were implemented in accordance with the Construction Stormwater General Permit issued to ARC by the Virginia Department of Conservation and Recreation.

- Surveyor documentation of pre-excavation topography;
- Installation of E&S controls including silt fencing, diversion ditches, sediment traps and hay bales; and
- Geophysical survey of each area for mark-out of subsurface utilities.

Appendix C includes the pre-excavation topography surveys performed for each non-debris and debris IM area. Appendix D includes the geophysical survey data for each debris and non-debris IM area.

The following information is provided for each of the non-debris, surface debris[3] (debris piles) and buried debris removal area:

- Summary of Investigation/Pre-Removal Delineation Sampling and Pre-Removal Risk Estimates (Non-Debris and Surface Debris Areas)
- Summary of Excavation Activities
- Summary of Post-Excavation Sampling (Debris Areas only)
- Assessment of Post-Excavation Residual Risks
- Restoration Activities

Excavation of the non-debris soil removal areas was performed to the limits of excavation based on the results of SRFI sampling and pre-removal sampling. All excavation activities for the non-debris soil IM areas warranting remediation were completed in 2012, including backfill and restoration with the exception of SRA 4, which could not be backfilled due to the presence of accumulated storm water in the excavation; backfill and restoration of SRA 4 was completed in in 2013.

The following sections provide additional details regarding the results and excavation/restoration activities, if warranted, performed in each soil IM area.

3.3.1 SRA 4

Excavation Delineation

As described in the USEPA approved *Soil IM Work Plan*, SRA 4 was identified for soil excavation primarily based on the presence of PCBs. Pre-removal sampling was conducted at locations SRA4-1 through SRA4-46 (see Figure 3-1A) in 2011 and 2012 to complete delineation of elevated PCB concentrations in the SRA 4 soil IM area.

As shown in Table 3-4, the pre-excavation upper-bound location-specific risk estimates for the locations within SRA 4 were above the USEPA risk limits for routine worker and construction worker at 22 locations. Based upon the iterative removal analysis, the extent of excavation needed to achieve acceptable commercial/industrial risk was determined. Appendix E identifies the sample locations and depths warranting removal.

[3] Surface debris areas were treated in the Soil IM program in a manner similar to non-debris IM areas.

Soil Removal Activities

Prior to initiation of SRA 4 soil excavation, the remnant slab from Building 43 required demolition and removal. Slab removal was completed on June 4, 2012. Following slab removal, a geophysical survey was performed for utility mark-out. The geophysical report is provided in Appendix D. Additional soil samples were collected from the area beneath the Building 43 slab to complete characterization of soil contamination in this area (these results were included in the risk analysis described above and summarized on Table 3-4).

Excavation of soil from SRA 4 began on August 21, 2012 and was completed on October 18, 2012. Soil was excavated within SRA 4 to the lateral extent defined in the *Soil IM Interim Report,* as shown on Figure 3-1A and to a depth of approximately 14 feet.
During the soil removal activities, storm water and groundwater accumulated in the excavation. Samples of the water were collected on February 28, 2013 (ARC-145686-SRA4 W) and analyzed for VOCs, PCBs, perchlorate, and metals (including mercury, antimony, selenium and thallium) – the constituents of concern based on prior sampling in this area. Based on the analytical results (see Appendix F) and discussions regarding water management during the January 22, 2013 meeting with USEPA and VADEQ[4], it was determined that off-site disposal of this water would be warranted prior to backfilling the excavation. Water removal began to allow for backfilling the excavation on April 9, 2013 and was completed on April 26, 2013. Further details regarding the handling of water are provided in Section 3.7.6.

Backfill of the SRA 4 excavation was completed on May 1, 2013, and the area was hydroseeded on May 2, 2013. Based on the post-excavation survey, the estimated in-place volume of soil removed from the SRA 4 area was 1,580 CY. A post-excavation survey drawing is provided in Appendix G.

Post-Removal Risks Evaluation

As shown in Table 3-2, the post-excavation upper-bound risk estimates are below USEPA limits for industrial/commercial land use and redevelopment construction workers. Therefore, the objectives of the soil IM program were achieved in this area.

3.3.2 SRA 5

Excavation Delineation

As described in the *Soil IM Work Plan*, SRA 5 was identified for soil excavation primarily based on the presence of PCBs. Pre-removal sampling was conducted at locations SRA5-1 through SRA5-41 (see Figure 3-1B) in 2011 and 2012 to complete delineation of elevated PCBs concentrations in the SRA 5 soil IM area.

As shown in Table 3-4, the pre-excavation upper-bound location-specific risk estimates for locations within SRA 5 were above USEPA risk limits for routine worker and construction worker receptors at 18 locations. Based upon the iterative removal analysis, the extent of excavation

[4] Based on discussions with VADEQ and USEPA, management of accumulated water in completed excavations included on-site discharge or off-site treatment, dependent on the results of analytical testing of the accumulated water.

needed to achieve acceptable commercial/industrial risk was determined. Appendix E identifies the sample locations and depths warranting removal.

Soil Removal Activities

Prior to initiation of SRA 5 soil excavation, the remnant slabs remaining from the demolition of Building 15 and Building 15 Annex required demolition and removal, and five wells required abandonment. Well abandonment activities were completed on March 29, 2012. Slab demolition and removal was completed on June 20, 2012. Following slab removal and well abandonment, E&S controls were put in place and a geophysical survey was performed for utility mark-out. The geophysical report is provided in Appendix D. Additional soil samples were collected to complete characterization of soil contamination in this area (these results were included in the risk analysis described above and summarized on Table 3-4).

Excavation of soil from SRA 5 began on August 21, 2012 and was completed on September 24, 2012. Soil was excavated within SRA 5 to the lateral extent defined in the *Soil IM Interim Report*, as shown on Figure 3-1B. In the area directly southwest of the Building 15, excavation was performed to the bedrock surface. In the other areas around the building, the depth of the excavation was 2 feet. In the area of the ephemeral stream, the depth of the excavation was to bedrock (4 ft below ground surface [bgs]) west of the stream and 2 feet east of the stream.

Backfill of the excavation at SRA 5 was completed on October 26, 2012 and the area was hydroseeded on November 6, 2012. Based on the post-excavation survey, the estimated volume of soil removed from SRA 5 was 1,127 CY. A post-excavation survey drawing is provided in Appendix G.

Post-Removal Risk Evaluation

As shown in Table 3-2, the post-excavation upper-bound risk estimates are below USEPA limits for industrial/commercial land use and redevelopment construction workers. Therefore, the objectives of the soil IM program were achieved in this area.

3.3.3 SRA 6 (North)

Excavation Delineation

As described in the *Soil IM Work Plan* (Geosyntec 2011), SRA 6 (North) was identified for soil excavation primarily based on the presence of PCBs. Pre-removal sampling was conducted at locations SRA6-1 through SRA6-12 (Figure 3-1C) in April and October 2011 to complete delineation of elevated PCBs concentrations in the SRA 6 (North) soil IM area.

As shown in Table 3-4, the pre-excavation upper-bound location-specific risk estimates for locations within SRA 6 (North) were above USEPA risk limits for routine worker and construction worker receptors at 2 locations. Based upon the iterative analysis, the extent of excavation needed to achieve acceptable commercial/industrial risk was determined. Appendix E identifies the sample locations and depths warranting removal.

Soil Removal Activities

Prior to initiation of SRA 6 (North) soil excavation, several wells were abandoned (performed March 28-29, 2012), trees located in the planned footprint of the sedimentation basin were

removed, E&S controls were put in place, and a geophysical survey was performed for utility mark-out. The geophysical report is provided in Appendix D.

Excavation of soil from SRA 6 (North) began on July 25, 2012 and was completed on September 12, 2012. Soil was excavated within SRA 6 (North) to the lateral extent defined in the *Soil IM Interim Report*, as shown on Figure 3-1C, and to a depth of 4 feet (bedrock).

Backfill of the excavation was completed on October 22, 2012, and the area was hydroseeded on November 6, 2012. The estimated volume of soil removed from SRA 6 (North) was 717 CY. A post-excavation survey drawing is provided in Appendix G.

Post-Removal Risk Evaluation

As shown in Table 3-2, the post-excavation upper-bound risk estimates for industrial/commercial land use and redevelopment construction workers are below USEPA limits. Therefore, the objectives of the soil IM program were achieved in this area.

3.3.4 SRA 6 (South)

As described in the *Soil IM Work Plan*, SRA 6 (South) was identified for soil excavation primarily based on the presence of PCBs. Pre-removal sampling was conducted at locations SRA6-8, SRA6-9, and SRA6-10 (Figure 3-1D) in April 2011 to complete delineation of elevated PCBs concentrations in the SRA 6 (South) soil IM area.

As shown in Table 3-4, the pre-excavation upper-bound location-specific cumulative cancer and HI risk estimates for this non-debris soil IM area were above USEPA's risk limits for routine worker exposure at location 2 GP-09. Following the method outlined in Section 3.2, a 95% UCL on the mean was calculated for PCBs within a half-acre area of this location. As shown on Tables 3-1 and 3-3, using a conservative estimate of the 95% UCL on the mean for PCBs reduces the HI estimates for SRA 6 (South) to below USEPA's limit of 1 under industrial/commercial land use. Therefore, soil excavation was not necessary in this area to achieve the objectives of the soil IM program.

3.3.5 SRA 8 (SR-40B Area)

Excavation Delineation

As described in the *Soil IM Work Plan*, SRA 8 was identified for soil excavation primarily based on the presence of tetrachloroethene (PCE). Pre-removal sampling was conducted at locations IM14-1 through IM14-7 (Figure 3-1E) in April 2011 to complete delineation of elevated PCE concentrations in the area.

As shown in Table 3-4, the pre-excavation upper-bound location-specific risk estimates for locations within SRA 8 were above USEPA risk limits for routine worker and construction worker receptors at 1 location. Based upon the iterative removal analysis, the extent of excavation needed to achieve acceptable commercial/industrial risk was determined. Appendix E identifies the sample locations and depths warranting removal.

Soil Removal Activities

Prior to initiation of SRA 8 soil excavation, several wells were abandoned in late March 2012. E&S controls were put in place and a geophysical survey was performed for utility mark-out. The geophysical report is provided in Appendix D.

Excavation of soil from SRA 8 began on July 30, 2012 and was completed on July 31, 2012. Overall, soil was excavated within SRA 8 to the lateral extent defined in the *Soil IM Interim Report*, as shown on Figure 3-1E, and to a depth of 8 feet.

Backfill of the excavation was completed on September 18, 2012, and the area was hydroseeded on November 6, 2012. The estimated volume of soil removed from SRA 8 was 255 CY. A post-excavation survey drawing is provided in Appendix G.

Post-Removal Risk Evaluation

As shown in Table 3-2, the post-excavation upper-bound risk estimates for industrial/commercial land use and redevelopment construction workers are below USEPA limits. Therefore, the objectives of the soil IM program were achieved in this area.

3.3.6 SRA 9 (GPBG-02 Area)

Excavation Delineation

As described in the *Soil IM Work Plan*, SRA 9 was identified for soil excavation primarily based on the presence of manganese. Pre-removal sampling was conducted at locations IM11-1 through IM11-10 in April and December 2011 and January 2012 (Figure 3-1F) to complete characterization of manganese concentrations in this area.

As shown in Table 3-4, the pre-excavation upper-bound location-specific risk estimates for locations within SRA 9 were above USEPA risk limits for routine worker and construction worker receptors at 2 locations. Based upon the iterative removal analysis, the extent of excavation needed to achieve acceptable commercial/industrial risk was determined. Appendix E identifies the sample locations and depths warranting removal.

Soil Removal Activities

Prior to initiation of SRA 9 soil excavation, E&S controls were put in place and a geophysical survey was performed for utility mark-out. The geophysical report is provided in Appendix D.

Excavation of soil from SRA9 began on July 26, 2012 and was completed on the same day. Overall, soil was excavated within SRA 9 to the lateral extent defined in the *Soil IM Interim Report*, as shown on Figure 3-1F, and to a depth of 2 feet.

Backfill of the excavation was completed on September 17, 2012, and the area was hydroseeded on November 6, 2012. The estimated volume of soil removed from SRA 9 was 60 CY. A post-excavation survey drawing is provided in Appendix G.

Post-Removal Risk Evaluation

As shown in Table 3-2, the post-excavation upper-bound risk estimates for construction worker exposure to soil in this area were above USEPA limits, which is predominantly due to a

manganese soil concentration at location IM11-2. As discussed in Section 3.2, a 95% UCL on the mean was calculated for manganese and cobalt within a half-acre area of IM11-2. As shown on Table 3-3, using a conservative estimate of the 95% UCL on the mean for manganese and cobalt reduces the construction worker HI estimate to meet USEPA's limit of 1. Therefore, the objectives of the soil IM program were achieved in this area.

3.3.7 SRA 10 (B22AEC-1S Area)

Excavation Delineation

SRA 10 was identified for soil excavation primarily based on the presence of perchlorate. Pre-removal sampling was conducted at locations SRA10-1 through SRA10-11 (Figure 3-1G) in June 2012 to complete delineation of elevated perchlorate concentrations in the area.

As shown in Table 3-4, the pre-excavation upper-bound location-specific risk estimates for locations within SRA 10 were above USEPA risk limits for a construction worker receptor at 1 location. Following the method outlined in Section 3.2, a 95% UCL on the mean was calculated for perchlorate within a half-acre area of this location. As shown on Table 3-1, using a conservative estimate of the 95% UCL on the mean for perchlorate reduces the HI estimates for SRA 10 to below USEPA's limit of 1 under industrial/commercial land use. Therefore, soil excavation in this area was not necessary to achieve the soil IM objectives.

Soil Removal Activities

Following demolition of Building 22, ARC elected to remove soils present beneath the building floor slab that exhibited elevated perchlorate concentrations. In addition, well abandonment was required; well abandonment activities were completed in late March 2012. Slab demolition and removal was completed on June 7, 2012. Following slab removal and well abandonment, E&S controls were put in place and a geophysical survey was performed for utility mark-out. The geophysical report is provided in Appendix D. Additional soil samples were collected to complete characterization of soil contamination in this area (these results were included in the risk analysis described above).

Excavation of soil from SRA 10 began on September 4, 2012 and was completed on the same day. Soil was excavated within SRA 10 to the lateral extent shown on Figure 3-1G and to a depth of 2 feet.

Backfill of the excavation at SRA 10 was completed on September 17, 2012, and the area was hydroseeded on November 6, 2012. Based on the post-excavation survey, the estimated volume of soil removed from SRA 10 was 81 CY. A post-excavation survey drawing is provided in Appendix G.

Post-Removal Risk Evaluation

As shown in Table 3-2, the post-excavation upper-bound risk estimates for industrial/commercial land use and the redevelopment construction worker receptor are below USEPA limits. Therefore, the objectives of the soil IM program were achieved in this area.

3.3.8 SRA 11 (B4AEC-1S Area)

Excavation Delineation

SRA 11 was identified for soil excavation primarily based on the presence of perchlorate. Pre-removal sampling was conducted at locations SRA11-1 through SRA11-8 (Figure 3-1H) in June 2012 to complete delineation of elevated concentrations in the area.

As shown in Table 3-1, the pre-excavation upper-bound location-specific risk estimates for SRA 11 were above USEPA risk limits for construction worker receptors at 1 location (see Table 3-4). Based upon the iterative analysis, the extent of excavation needed to achieve acceptable commercial/industrial risk was determined. Appendix E identifies the sample locations and depths warranting removal.

Soil Removal Activities

Prior to initiation of SRA 11 soil excavation, demolition of Building 4 was completed on June 7, 2012. Following slab removal, E&S controls were put in place and a geophysical survey was performed for utility mark-out. The geophysical report is provided in Appendix D. Additional soil samples were collected to complete characterization of soil contamination in this area (these results were included in the risk analysis discussed above and summarized on Table 3-4).

Excavation of soil from SRA 11 began on August 21, 2012 and was completed on the same day. Soil was excavated within SRA 11 to the lateral extent shown on Figure 3-1H, and to a depth of 2 ft.

Backfill of the excavation at SRA 10 was completed on September 17, 2012, and the area was hydroseeded on November 6, 2012. Based on the post-excavation survey, the estimated volume of soil removed from SRA 11 was 49 CY. A post-excavation survey drawing is provided in Appendix G.

Post-Removal Risk Evaluation

As shown in Table 3-2, the post-excavation upper-bound risk estimates for industrial/commercial land use and the construction worker receptor are below USEPA limits. Therefore, the objectives of the soil IM program were achieved in this area.

3.3.9 IM-3 (6450-2000 Area)

As described in the *Soil IM Work Plan*, area IM-3 was identified for potential soil excavation primarily based on the presence of PAHs. Pre-removal sampling was conducted at locations IM13-1 through IM13-5 (Figure 3-1I) in April 2011 to complete delineation of elevated PAHs in the area.

As shown in Table 3-1, the pre-excavation cumulative cancer and HI risk estimates for this non-debris soil IM area for routine worker and construction worker receptors to soil were below USEPA's risk limits. Therefore, soil excavation was not necessary in this area to achieve the soil IM objectives.

3.4 Summary of Completed Surface Debris Area Soil IM Activities

According to Section 3.2.1 of the *Soil IM Work Plan*, the three surface debris areas were identified as having a sampling location soil concentrations beneath the surface debris exceeding the commercial/industrial RSLs. While these surface debris piles are no longer present, the debris is expected to have been the source of the elevated concentrations. These areas were included in the soil IM program and evaluated and addressed in a manner consistent with the non-debris soil IM areas.

3.4.1 IM-2 (7800-152 Area)

As discussed in the *Soil IM Work Plan*, additional samples were collected at IM12-1 through IM12-5 (Figure 3-2A) in April 2011 to further characterize arsenic concentrations at 7800-152.

As shown in Table 3-1, the pre-excavation upper-bound risk estimates for the locations within area IM-2 are all below USEPA risk limits. Therefore, soil excavation was not necessary to achieved the soil IM objectives. The soil boring locations associated with IM-2 are shown on Figure 3-2A.

3.4.2 IM-9 Area (3700-33 Area)

As discussed in the *Soil IM Work Plan*, additional samples were collected at IM9-1 through IM9-5 (Figure 3-2B) in April 2011 to complete characterization of SVOC and arsenic concentrations around sample location 3700-33.

As shown in Table 3-1, the pre-excavation upper-bound risk estimates for the locations within area IM-9 are all below USEPA risk limits. Therefore, soil excavation was not necessary to achieve the soil IM objectives. The soil boring locations associated with IM-9 are shown on Figure 3-2B.

3.4.3 IM-10 Area (3800-46 Area)

As discussed in the *Soil IM Work Plan*, additional samples were collected at IM10-1 through IM10-5 (Figure 3-2C) in April 2011 to complete characterization of PCBs and arsenic concentrations around sample location 3800-46.

As shown in Table 3-1, the pre-excavation upper-bound risk estimates for the locations within area IM-10 are all below USEPA risk limits. Therefore, soil excavation was not necessary to achieve the soil IM objectives. The soil boring locations associated with IM-10 are shown on Figure 3-2C.

3.5 Summary of Completed Buried Debris Areas

Excavation in each of the four buried debris areas (SRA 1, SRA 2A/2B, SRA 3, and SRA 7) was performed to complete the removal of visible debris. Excavation ceased either when visible debris was no longer encountered or when bedrock was encountered. Excavated materials were screened for removal of Material Potentially Presenting an Explosive Hazard (MPPEH). Scrap metal, tires, concrete/masonry materials, large rocks and wood debris were also removed from the excavated soil and staged separately. This allowed for the excavated and screened soil to be used as landfill cover if waste characterization analytical results supported a non-hazardous waste classification.

MPPEH was further screened to determine if energetic materials were present or if the MPPEH was to be considered Munitions Debris (MD). Munitions and Explosives of Concern (MEC) were identified, recorded and staged in an on-site magazine (Magazine 39) pending off-site disposal. MD was demilitarized on site and established as Material Documented as Safe (MDAS) for off-site smelting/destruction. Section 3.5 provides details related to the MPPEH, MEC and MD finds associated with the debris areas as well as the general debris encountered in these areas.

3.5.1 SRA 1

Soil Removal Activities

Prior to initiation of soil excavation in SRA 1, a geophysical survey was performed on March 19, 2012. The geophysical report is provided in Appendix D. Installation of E&S controls was completed by April 10, 2012 and excavation and screening activities began on April 13, 2012 and continued through August 9, 2012. Excavation within SRA 1 was completed to the lateral extent shown on Figure 3-3A. Following completion of the debris removal, post-excavation soil sampling was conducted at the locations shown on Figure 3-3A.

SRA 1 was backfilled to within six inches of final grade by August 30, 2012. As discussed below, a test pitting investigation activity was completed in this area following the SRA 1 excavation (Area A; see Section 3.6.2). Upon completion of the test pitting investigation, backfilling of SRA 1 was completed on October 23, 2012, and the area was hydroseeded on November 6, 2012.

An estimated 3,202 CYs of soil/debris were removed from the SRA 1 debris area along with 46 MEC and 1,683 MD. A copy of the post-excavation survey is provided in Appendix G. Overall, during excavation the following material was encountered:

- Grayish/black soil, debris and sludge-like material;
- Oil-stained soil and debris, that included drum pieces and exhibited petroleum odors; and
- Soil exhibiting visual staining and/or odors.

The material staged in these roll-off containers was sampled. The sample IDs were as follows:

- ARC-145686-SOILCHAR-006 (representing the 2 roll-off containers of grayish/black material).
- ARC-145686-SOILCHAR-007 (representing the 10 roll-off containers of oil-stained material).
- ARC-145686-SOILCHAR-011 (representing 4 roll-off containers of potentially contaminated soil)

The results of these analyses are presented in Appendix H. Based on these results, the materials in the first twelve roll-off containers listed above were classified as non-hazardous and were disposed at the Old Dominion Landfill as non-hazardous debris (134.31 tons, total), as documented in Appendix I. The materials in the last four roll-off containers noted above were

classified as hazardous and were disposed at the Environmental Quality Company (EQ) facility in Wayne, MI (41.70 tons, total), as documented in Appendix J.

Post-Removal Risk Evaluation

As shown in Tables 3-2, the post-excavation upper-bound risk estimates for routine worker exposure to soil in this area were above USEPA risk limits, which is predominantly due to PCBs and cobalt soil concentrations at location SRA1-TPA10-BASE2. As discussed in Section 3.2, a 95% UCL on the mean concentrations was calculated for PCBs and cobalt within a half-acre area of this location. As shown on Table 3-3, using a conservative estimate of the 95% UCL on the mean for PCBs and cobalt reduces the routine worker HI estimate to meet USEPA's limit of 1. Therefore, the objectives of the soil IM program were achieved in this area.

3.5.2 SRA 2A

Soil Removal Activities

Excavation and screening activities from SRA 2A began on April 24, 2012 and continued through June 21, 2012. The lateral extent of soil excavation in SRA 2A is shown in Figure 3-3B. Following completion of the debris removal, post-excavation soil sampling was conducted at the locations shown on Figure 3-3B.

A post-excavation survey was performed on July 11, 2012 (see Appendix G) and the excavation was backfilled to within six inches of grade July 17-25, 2012. SRA 2A was not backfilled to final grade, as additional test pitting work in this area required that equipment traverse portions of SRA 2A (Area B; see Section 3.6.2). Final backfill and grading of this area was completed in February 2013. Overall, an estimated 3,307 in-place CYs of soil/debris were removed from the SRA 2A area along with 8 MEC and 162 MD. A copy of the post-excavation survey is provided in Appendix G.

Soil with debris and odor was encountered during the removal activities. Samples of the soil in the roll-off containers were collected on May 23, 2012 (ARC-145686-SRA2A-001) and June 13, 2012 (ARC-145686-SRA2A-001A). ARC-145686-SRA2A-001 was analyzed for SVOCs, metals (including mercury, arsenic, selenium, lead and thallium), cyanide, pesticides, perchlorate, explosives and pH. ARC-145686-SRA2A-001A was analyzed for TCLP VOCs, metals (including mercury), TPH GRO/DRO, PCBs and perchlorate, to complement the analyses performed on the May 23, 2012 sample as needed for waste characterization. A copy of the analytical data reports are provided in Appendix H.

Based on the analytical results of both the May 23, 2012 and June 13, 2012 waste characterization samples, the soil in these nine roll-off containers was classified as non-hazardous and was approved for disposal at the Old Dominion Landfill in Richmond, VA. The amount of soil disposed was 131.88 tons, as documented in Appendix I.

Post-Removal Risk Evaluation

As shown in Tables 3-2, the post-excavation upper-bound risk estimates for the locations within SRA 2A are all below USEPA risk limits under industrial/commercial land use and for the redevelopment construction worker. Therefore, the objectives of the soil IM program were achieved in this area.

3.5.3 SRA 2B

Soil Removal Activities

Excavation and screening activities from SRA 2B began on June 19, 2012 and continued through August 1, 2012. The lateral extent of soil excavation in SRA 2B is shown in Figure 3-3B. Following completion of the debris removal, post-excavation soil sampling was conducted at the locations shown on Figure 3-3B.

A post-excavation survey was performed on August 9, 2012 (see Appendix G) and the area was backfilled to within six inches of final grade by September 12, 2012. Placement of the last 6-inch lift of soil was performed from October 23-25, 2012, and the area was hydroseeded on November 6, 2012. An estimated 4,686 in-place CYs of soil/debris were removed from the SRA 2B debris area along with 91 MEC and 635 MD. A copy of the post-excavation survey is provided in Appendix G.

During excavation operations, soil with debris and odor (similar to that odor noted during SRA 2A) was encountered. A sample of the stockpiled material was collected on July 30, 2012 (ARC-145686-SOILCHAR-013) and sent off site for waste characterization analysis. The results confirmed that the material was non-hazardous; therefore, it was transferred to the non-hazardous soil staging area at the Building 107 slab. The results for sample ARC-145686-SOILCHAR-013 are presented in Appendix H.

Post-Removal Risk Estimates

As shown in Tables 3-2, the post-excavation upper-bound risk estimates for the locations within SRA 2B are all below USEPA risk limits for industrial/commercial land use and redevelopment construction worker. Therefore, the objectives of the soil IM program were achieved in this area.

3.5.4 SRA 3

Soil Removal Activities

Following pre-excavation surveying, geophysical surveying, and installation of E&S controls, excavation and screening activities from SRA 3 began on July 12, 2012 and continued through July 19, 2012. The extent of soil excavation in SRA 3 is shown in Figure 3-3C. Following completion of the debris removal, post-excavation soil sampling was conducted at the locations shown on Figure 3-3C. A copy of the post-excavation survey is provided in Appendix G.

Backfill operations were completed to within six inches of final grade on August 30, 2012, after which test pitting in this area was initiated (Area C, see Section 3.6.2). Final backfill/grading was completed on October 23, 2012, and hydroseeding of the area was completed on November 6, 2012. An estimated 346 in-place CYs of soil/debris were removed from the SRA 3 debris area with no MEC encountered and one MD identified.

Excavated soil was stockpiled on plastic liner at the central soil staging area (slab of former Building 107). A sample of the stockpiled material was collected on August 8, 2012 (ARC-145686-SRA3) and sent off site for waste characterization analysis. The results confirmed that the material was non-hazardous. The results for sample ARC-145686-SRA3 are presented in Appendix H.

Post-Removal Risk Estimates

As shown in Tables 3-2, the post-excavation upper-bound risk estimates for the locations within SRA 3 for industrial/commercial land use and redevelopment construction worker are all below USEPA risk limits. Therefore, the objectives of the soil IM program were achieved in this area.

3.5.5 SRA 7

Soil Removal Activities

Prior to the initiation of excavation and screening, E&S controls were installed in March and April 2012, and the geophysical survey was also performed from March 21-22, 2012. Two small slabs north of Building 107 were demolished and removed on September 24, 2012 and two slabs south of Building 107 were demolished and removed on September 25, 2012.

Excavation of SRA 7 began on September 25, 2012 and continued through February 2013. The lateral extent of soil excavation in SRA 7 is shown in Figure 3-3D. Following completion of the debris removal, post-excavation soil sampling was conducted at the locations shown on Figure 3-3D. A copy of the post-excavation survey is provided in Appendix G.

Following completion of soil excavation activities, storm water accumulated in the excavation. Based on analytical results associated with accumulated storm water from the excavation (see Section 3.7.6 regarding water handling on site) was pumped from the open excavation to the surrounding ground surface on February 13-14, 2013, consistent with discussions during the January 22, 2013 meeting with USEPA and VADEQ.

The excavation was backfilled March 5-6, 2013. Removal of the remaining Building 107 slab was performed from February 20, 2013 to March 5, 2013, after the majority of staged soil had been removed from the site. The final phase of SRA 7 area geophysical surveying was completed following removal of the remaining Building 107 slab, on March 12, 2013, after which the test pitting program for this area was finalized. Overall, approximately 806 in-place CYs of soil/debris were removed from SRA 7 along with 2 MEC and 60 MD.

Excavated soil was stockpiled on plastic liner at the central soil staging area (slab of former Building 107). A sample of the stockpiled material was collected on September 25, 2012 (ARC-145686-SOILCHAR-014) and sent off site for waste characterization analysis. The results confirmed that the material was non-hazardous. The results for sample ARC-145686-SOILCHAR-014 are presented in Appendix H.

Post-Removal Risk Estimates

As shown in Tables 3-2, the post-excavation upper-bound risk estimates for the locations within SRA 7 for industrial/commercial land use and redevelopment construction worker are all below USEPA risk limits. Therefore, the objectives of the soil IM program were achieved in this area.

3.6 Summary of Test Pit Activities

As discussed in Section 2.6, test pit investigations of suspect areas were conducted in Area A (around SRA 1), Area B (around SRA 2A/B), Area C (around SRA 3) and Area D (around SRA 7) during the soil IM program to assess the potential presence of buried hazardous debris in these areas. The following section provides a summary of the test pits excavation activities.

3.6.1 Identification of Areas for Test Pits

Test pits investigations were performed in areas identified with geophysical anomalies or where debris and other materials were known or suspected to have been buried in the past. The investigations were performed in order to determine the nature of the any potential debris remaining on-site, confirm the success of historical removal activities, and complete soil sampling to identify remaining soil impacts. The lateral excavation extent of each area was defined by the extent of potential buried debris. For each of the four identified areas (Areas A through D), the geophysical data available for that area as well as aerial photography for each area were reviewed to determine what areas had the greatest potential for possible remnant hazardous/energetic materials.

3.6.2 Summary of Test Pit Activities

Based on this review of available information, a test pit investigation program was developed as follows:

1. Locate limits of suspected area using a licensed land surveyor, and mark the test pit locations in the field using survey coordinates from site mapping.
2. Excavate the test pit location to a depth of several feet to identify the source of the geophysical anomaly.
3. Determine if the source of the anomaly was an item of concern (e.g., MPPEH) or if the source was construction or other non-hazardous debris (e.g., metal fence posts).
4. Inspect the excavated soil for evidence of burning operations (e.g., ash residues) or soil staining.

5a. If the source of the anomaly was non-hazardous debris and there was no evidence of burning operations or stained soil, then terminate the test pit work at that location and backfill the test pit.

5b. If the source of the anomaly was an item of concern and/or if the soil showed evidence of burning operations or stained soil, then excavate the test pit through test trenching to the extent that the items of concern and/or charred soil was removed.

6. If a test pit was expanded to a test trench and soil staining remained after debris removal, then conduct post-excavation soil samples at the conclusion of the debris excavation activiites.

This site-specific test pit investigation approach allowed for iterative field decisions that relied on the nature and characteristics of the soil and debris observed in the test pits, and the professional opinion of trained and certified UXO specialists provided by Shaw, to determine the extent of the test pits and soil/debris removal areas.

Appendix K includes a summary table of test pit investigation and Appendix F includes the post-excavation analytical data associated with the test pit investigation program.

Overall, the test pit program uncovered the following MPPEH:

- Area A TPs – 1 MEC, 190 MD
- Area B TPs – 0 MEC, 32 MD
- Area C TPs – 0 MEC, 1 MD
- Area D TPs – 0 MEC, 0 MD

In Area B, along with the MD noted above, propellant (1,146 lbs net explosive weight / 1,221 lbs gross weight) was encountered and drummed for off-site disposal with other energetic materials from the soil IM program. Each test pit area was backfilled and hydroseeded, as discussed in Section 3.5

Area A Test Pits

The test pits in Area A were conducted in the western and southern sections of SRA 1. The test pit locations are shown Figure 3-3A. Post-excavation soil samples were collected for analysis from TPA4, TPA5, TPA6, TPA7, TPA10, TPA11, and TPA12. As shown in Table 3-5, the post-excavation upper-bound risk estimates for the locations associated with these test pits were above USEPA risk limits for routine worker exposure at one location (SRA1-TPA10-BASE2). A 95% UCL on the mean was calculated for PCBs and cobalt within a half-acre of this location, as discussed in Section 3.5.1. As shown on Table 3-3, using a conservative estimate of the 95% UCL on the mean for PCBs and cobalt reduces the routine worker HI estimate for SRA 1 to meet USEPA's limit of 1. Therefore, no further investigation was warranted in this area.

Area B Test Pits

The test pits in Area B were conducted in northern section of SRA 2A and western section of SRA 2B. The test pit locations are shown on Figure 3-3B. Post-excavation soil samples were collected for analysis from TPB11 and TPB12 at SRA 2A and from TP-B15, TP-B16, and TP-B17 at SRA 2B. As shown in Table 3-5, the post-excavation upper-bound risk estimates for the locations associated with these test pits are below USEPA limits under industrial/commercial land use. Therefore, no further investigation was warranted in this area.

Area C Test Pits

The test pits in Area C were conducted in eastern and southern section of SRA 3 and SRA 4. The test pit locations are shown Figures 3-3D and 3-1A, respectively. Post-excavation soil samples were collected for analysis from TPC3 at SRA 3 and from TPC4 at SRA 4.

As shown in Table 3-5, the post-excavation upper-bound risk estimates for the locations associated with these test pits for industrial/commercial land use are below USEPA limits. Therefore, no further investigation was warranted in this area.

Area D Test Pits

The test pits in Area D were conducted in SRA 7. No debris, evidence of burning or discolored soil was found in the test pits dug in Area D and therefore no soil samples were collected.

3.7 Waste Handling

As wastes were generated through implementation of soil IM activities (i.e., debris area and non-debris area excavations), samples of the excavated materials were collected and analyzed off-site for waste characterization. Samples were collected and submitted to the laboratory (Microbac Laboratories – Ohio Valley Division) for analysis as required by the various disposal facilities.

Appendix H provides a summary of the waste characterization samples collected throughout the soil IM project, including samples for soil, water and concrete waste characterization.

3.7.1 Non-Hazardous Soil

Non-hazardous soil from the various excavation areas (i.e., debris areas, non-debris areas and test pit remediation areas) was shipped to the Old Dominion Landfill in Richmond, VA. The majority of the soil shipped to Old Dominion was approved for use as daily cover given the level of screening and debris removal completed on-site prior to transport off-site. Soil from the debris areas was approved for disposal through routine waste characterization sampling as soil was generated. Appendix H includes a complete list of the soil disposal characterization sampling and analysis work as well as copies of the analytical data reports. Table 3-6 contains brief summary of the samples collected from the debris area screened soil stockpiles.

Soil from the non-debris areas was approved for disposal through presentation of the delineation sampling results from each of the areas. Soil generated by test pit investigation activities was also sampled for disposal approval. Appendix H includes a complete list of the soil disposal characterization sampling and analysis work as well as copies of the analytical data reports.

The test pit soil that was accumulated from Area A test pit remediation areas and from Area C test pit remediation areas was sampled in 2012. Soil removed from 2013 test pit remediation work performed in Area B was sampled as three separate samples – TP-B11, TP-B12, and TP-B12A. The first two samples represented material from noted test pits. The third sample, TP-B12A, was a sample of soil that had been segregated from other TP-B12 soil as it was suspected to be potentially hazardous due to field visual inspection and testing. In addition, the "test pit stockpile" samples, noted as ARC-145686SOILCHAR-015 and 016, were samples collected from test pit soil commingled from Area B 2012 test pit remediation work. Table 3-6 contains a summary of the samples collected from the test pit program excavated soil.

All of these samples confirmed that off-site disposal as non-hazardous soil at Old Dominion was appropriate.

A total of 24,941.93 tons of non-hazardous soil were disposed at the Old Dominion Landfill in Richmond, Virginia as summarized below:

2012 Soil - End Dumps	21,630.65	tons	842	loads
2012 Soil - Roll Offs (SRA 2A)	131.88	tons	9	boxes
2013 Soil - End Dumps	3,179.4	tons	126	loads
	24,941.93	tons	977	shipments

Copies of the non-hazardous waste manifests, as well as summary logs of the shipments, are included in Appendix I**.**

3.7.2 TSCA Soil

Soil exhibiting PCB concentrations in excess of TSCA limits was classified as TSCA-regulated and could not be disposed locally at the Old Dominion facility. This soil was, therefore, disposed at EQ Wayne Disposal, Inc. facility in Belleville, Michigan. TSCA soil was generated at non-debris areas SRA 4, SRA 5 and SRA 6. The analytical data generated through delineation sampling of these areas were used to characterize the waste and obtain disposal approvals.

In addition to the TSCA soil removed from the non-debris areas, there was a small area of stained soil at debris area SRA 1 which was segregated from other excavated soil and tested for disposal characteristics. This soil was also found to contain PCBs at a concentration requiring disposal at the EQ facility.

A total of 3,997.91 tons of soil were shipped to the EQ facility in Wayne, Michigan as summarized below:

2012 Soil - End Dumps	3,853.32	tons	153	Loads
2012 Soil - Roll Offs (SRA 1)	41.70	tons	4	Boxes
2013 Soil - End Dumps	2.89	tons	4	Loads
	3,997.91	tons	161	Shipments

Copies of the waste manifests, as well as summary logs of the shipments, are included in Appendix J.

3.7.3 Non-Hazardous Concrete

Concrete debris was generated in 2012 through demolition of the building slabs associated with several of the soil IM areas. Specifically, slab removal was performed at Building 4 (SRA 11), Building 15/15 Annex (SRA 5), Building 22 (SRA 10) and Building 43 (SRA 4). In addition, a portion of the slab associated with Building 107 (SRA 7) was demolished in 2012. As each slab was demolished, concrete samples were collected from multiple locations (five total) of the broken slab concrete – north, south, east, west and one from the center of the slab. The concrete pieces were rock size and composited into one 8-oz jar for off-site waste characterization analysis. These samples are listed on Table 3-6 and Appendix H includes the analytical data reports associated with these samples.

Concrete samples were analyzed for TCLP metals (including mercury), perchlorate, explosives and PCBs. Based on the waste characterization analytical results, the concrete was approved for disposal as debris at the Old Dominion Landfill in Richmond, Virginia. A total of 40 loads of concrete were shipped to Old Dominion in 2012 (totaling 696.39 tons of concrete). Appendix L includes a summary log of shipments as well as copies of the non-hazardous waste manifests.

In February 2013, as the remainder of the concrete slab for Building 107 was demolished, a second sample of this slab concrete was collected for off-site analysis (ARC-145686-SRA7-Conc2). As the historical activities in this building did not indicate concerns with respect to specific contaminants, it was necessary to collect a second sample to confirm that this concrete could be recycled versus non-hazardous disposal. As a result of the analyses for the Building 107 slab, it was determined that the concrete from this building slab was suitable for recycling.

The remaining Building 107 slab concrete that was demolished in early 2013 was shipped to Commonwealth Recycled Aggregates in Gainesville, VA for crushing and re-use. A total of 30 loads of concrete were transported off site between April 12, 2013 and April 15, 2013. Documentation of all concrete disposal, including Bill of Lading numbers and shipment dates, is provided in Appendix L.

3.7.4 Energetic Wastes

Energetic waste management performed during the soil IM program included munitions and explosives of concern (MEC) and inactive propellant generated as part of soil IM work and the Thermal Treatment Unit (TTU) excavation work completed as part of a RCRA corrective action prior to implementation of the soil IM work. Energetic materials were staged on-site in Magazine 18 prior to off-site disposal. Energetic wastes were shipped to the Clean Harbors facility in Colfax, LA via Tri-State Motor Transit (transporter).

Energetic Materials Associated with TTU Remediation – 2011 Pre-Soil IM Work

In early 2012, energetic materials and debris generated by 2011 excavation work in the TTU area required screening and final packaging for off-site disposal. The energetic management crew inspected and tested the materials staged in Magazine 18 to determine what materials were MEC or propellant and what materials could be considered MD. MD materials were staged for demilitarization while MEC and propellant materials were consolidated, inventoried and repackaged in preparation for shipment off site.

Included with the TTU wastes were lab-pack type materials, such as sample jars, small containers, etc. As there were no labels on the containers, they were placed into a sand pile and smashed using an excavator bucket to ensure the safety of site personnel. Once the containers had been broken and the contents mixed with the sand, a sample of the sand was collected and analyzed for waste characterization, including perchlorates and explosives. The results showed that energetic materials were present in the sand mix (perchlorate detected at 199 mg/kg). Therefore, this material was incorporated into the energetic waste shipments. Appendix H contains a copy of the analytical data report for the comingled sample, which was collected on April 13, 2012 (Microbac Lab ID L12040547-01/02).

The first shipments of MEC and propellant were performed in April 2012, as summarized below:

- TTU MEC Shipment No. 1 – April 23, 2012

Contents:	88 30-gallon fiber drums
Net Explosive Weight:	8,855 lbs
Gross Weight:	9,933 lbs

- TTU MEC Shipment No. 2 – April 26, 2012

Contents:	69 30-gallon fiber drums and 3 metal drums
Net Explosive Weight:	7,605 lbs
Gross Weight:	8,811 lbs

Appendix M provides a summary of the energetic materials associated with TTU operations, including the inventory sheets and the transportation/disposal documents.

Energetic Materials Associated with Soil Interim Measures – 2012/2013 Work

As debris area and test pit excavation work proceeded, as noted above, additional MEC and propellant were uncovered and staged in Magazine 18. Appendix N provides a summary list of the MEC found on site along with photos of each item logged. As noted in the summary list, some of the items assigned a "MEC" item number were later found, through field testing, to be MD. These items are also tracked in the MD log referenced in Section 3.7.5, below. MEC items noted in the summary list were primarily found in the various debris areas. Three of the items were found during inspection of the site buildings and one item was uncovered during the Area A test pit program.

As material was accumulated, shipments were scheduled. Two shipments were completed in 2012 and a final shipment was completed in April 2013, as summarized below:

- Soil IM MEC Shipment No. 1 – July 20, 2012 (Manifest #005605440)

  Three Pallets - two with solid propellant and one with explosive articles:

Pallet No. 1:	Net Explosive Weight =	413 lbs.,	Gross Weight =	472 lbs.
Pallet No. 2:	Net Explosive Weight =	450 lbs.,	Gross Weight =	581 lbs.
Pallet No. 3:	Net Explosive Weight =	30 lbs.,	Gross Weight =	67 lbs.
	Total Weights:	893 lbs.		1,120 lbs.

- Soil IM MEC Shipment No. 2 – November 7, 2012 (Manifest #005562860)

Contents:	19 fiber drums and 1 metal drum
Net Explosive Weight:	1,151 lbs.
Gross Weight:	2,190 lbs.

- Soil IM MEC Shipment No. 3 – April 24, 2013 (Manifest #006511522)

Contents:	13 fiber drums and 1 metal drum
Net Explosive Weight:	1,253 lbs.
Gross Weight:	1,318 lbs.

3.7.5 Munitions Debris – Demilitarized

MD segregated during the TTU remedial action, building cleanout, soil IM program and test pit investigation was temporarily staged in Magazine 39 (on site) prior to being demilitarized. Demilitarization was either done using a log splitter to deform smaller objects, such as rocket motors, or using the excavator and hammer for larger objects, such as mortar bodies. Demilitarization was performed per the requirements of DoD 4160.21-M-1 and the USEPA's Munitions Rule (62 FR 6621, February 12, 1997).

Once demilitarized (processed into MDAS), material was initially staged in individual drums pending off-site disposal. However, it was later determined that placement of demilitarized materials into a large locked SEA container would be more cost-effective. Appendix O provides a summary of the MD gathered as a result of TTU remedial action follow-up, soil IMs, and building cleanout work. Overall, 173 MD items were recovered through inspection of the TTU remedial action MPPEH materials generated in 2011, 2922 MD items were recovered through the 2012 soil IM work and building cleanout as well as test pitting, and 62 additional MD items were recovered in 2013 as soil IM work was completed and final waste screening was performed to dismantle the debris staging area on site. Overall, 3,157 MD items were recovered, demilitarized and disposed off-site.

The first container of MDAS was shipped to United Iron and Metal of Baltimore, MD for destruction and documentation of destruction on July 18, 2012. This included demilitarized materials from both the 2011 TTU work and the soil IM work. A second container of MDAS was shipped to the same facility on November 6, 2012. Both 2012 shipments were via SEA containers. The vendor provided drop off and pickup of the SEA containers, as well as SEA container rental, in exchange for the scrap value of the MD. Copies of the Certificate of Destruction for 2012 MD disposal is provided in Appendix O.

Additional MD was accumulated in 2013 and was held in Magazine 39 pending demilitarization and shipment off site. Appendix O provides a summary of the MD handled in 2013. The demilitarized materials were transported by Shaw Environmental, Inc. to Montgomery Scrap Corporation in Rockville, MD on March 26, 2013. A copy of the certificate of destruction and scrap payment are provided in Appendix O.

3.7.6 Storm Water from Excavation Areas

Storm water that accumulated in the various excavation areas was removed when required to facilitate the backfilling of excavated areas using either a pump to transfer the water into the on-site water truck or a subcontracted vacuum truck and operator. Water was transferred to on-site fractionating tanks for temporary storage pending treatment through the on-site treatment system. Over 150,000 gallons of water were treated through the on-site treatment system in 2012.

In 2013, due to the volume of water remaining in the open excavations, the storm water in the excavations was sampled to determine alternatives for handling of this water. The open excavations from 2012 work included Test Pits A-10 and A-11 in Area A (near SRA 1), the SRA 4 non-debris area excavation, and the SRA 7 debris area open excavation. There was also residual water in the fractionating tanks on-site that had been removed from SRA 5. All of these

waters were sampled on January 22, 2013. Table 3-7 summarizes the water samples collected in 2013. The laboratory data reports for these samples are provided in Appendix A.

As discussed with VADEQ, the resultant data were reviewed using both the surface water screening levels and groundwater screening levels, as summarized below:

Surface Water Screening Levels

- VADEQ surface water quality criteria (human and ecological based criterion);
- Risk-based surface water screening levels developed for the baseline RFI risk assessments which are consistent with current and reasonably expected future surface water exposures (i.e., recreational user and maintenance worker contact);

Groundwater Screening Levels

- Drinking water screening levels;
- Risk-based groundwater screening levels developed for the baseline RFI risk assessments which are consistent with current and reasonably expected future groundwater exposure scenarios (i.e., maintenance worker and construction worker contact); and
- Groundwater concentrations observed in wells nearby to these areas.

Based on this evaluation, the following assessment of storm water was conducted in consultation with VADEQ.

Test Pit Excavation TP-A10

One storm water sample and field duplicate sample were collected from the TP-A10 excavation. The samples were analyzed for VOCs, PCBs, cobalt, manganese, and perchlorate based on the soil data available from within this excavation area. Perchlorate was detected but at concentrations below all surface water and groundwater screening levels. Cobalt was detected at concentrations approximately six times higher than groundwater concentrations observed in monitoring wells in the vicinity of TP-10A. The only criteria the cobalt concentrations exceeded was the drinking water screening level. The concentrations did not exceed the surface water screening levels or risk-based groundwater screening levels which are consistent with potential current or future exposures. Manganese was detected at concentrations about three times higher than groundwater concentrations observed in monitoring wells in the area of TP-10A. The only criteria the manganese concentrations exceeded was the VADEQ surface water criterion. This water quality standard is not a risk-based standard, rather, according to VADEQ, it is a level necessary to “maintain acceptable taste, odor or aesthetic quality of drinking water”. So the concentrations of manganese in these samples were not considered to be of concern given current and future shallow groundwater exposures.

While the concentrations of cobalt were above the drinking water screening level and the concentrations of manganese were above the aesthetic-based VADEQ surface water criterion, these concentrations would not pose an unacceptable risk to human health or the environment. As such, the storm water in this excavation did not require treatment prior to discharge.

Test Pit Excavation TP-A11

One storm water sample was collected from the TP-A11 excavation. It was analyzed for VOCs, PCBs, cobalt, manganese, and perchlorate based on the soil data available from within this excavation area. PCBs were the only chemicals detected in the storm water sample. The PCB concentration was greater than the VADEQ surface water criterion and the risk-based recreator surface water screening levels. Since the PCB concentration was only greater than surface water screening levels, the storm water in this excavation did not warrant treatment prior to discharge as long as it was not discharged in a manner which could impact surface water (e.g., direct or indirect discharge to surface water features).

Excavation SRA 4

One storm water sample was collected from the SRA 4 excavation. It was analyzed for VOCs, PCBs, and perchlorate based upon the soil data available from within this excavation area. PCBs and perchlorate were detected in the water sample. The PCB concentration was greater than all surface water and groundwater screening levels. The perchlorate concentration was only greater than the drinking water screening level. Nearby groundwater monitoring wells had been sampled and analyzed for perchlorate but not for PCBs. The perchlorate concentration observed in the water was about ten times lower than concentrations observed in nearby groundwater. Since the PCB concentration was greater than all the identified screening levels, water was removed for treatment from this excavation to allow backfilling to be completed.

A second sample of water from the SRA 4 excavation was collected on February 28, 2013 and analyzed for VOCs, PCBs, perchlorate, and metals (including mercury, antimony, selenium and thallium), all as required by the off-site disposal facilities being considered for treatment/disposal of the excavation water. The results of these analyses supported non-hazardous treatment/disposal of the water.

Excavation SRA 7

One storm water sample was collected from the SRA 7 excavation. It was analyzed for VOCs, aluminum, and mercury based on the soil and groundwater data available from samples collected within and in the vicinity of this excavation area. Aluminum was the only chemical detected. The aluminum concentration was below all surface water and groundwater screening levels. As a result, storm water in this excavation did not require treatment prior to discharge.

Frac Tank

One water sample was collected from the frac tank. It was analyzed for VOCs, PCBs, aluminum, cobalt, iron, manganese, and perchlorate. PCBs, perchlorate, aluminum, cobalt, iron, and manganese were detected in the water sample. The PCBconcentration was greater than all surface water and groundwater screening levels. The perchlorate concentration was only greater than the drinking water screening level. The iron concentration was only greater than the VADEQ surface water quality criterion. The remaining detected chemical concentrations were below the screening levels. Since the PCB concentration was greater than all of the screening levels, water stored in the frac tank was taken off-site for treatment.

Summary

In summary, it was determined that the water from the open excavations at TP-A10, TP-A11 and SRA 7 could be discharged to the ground surface as long as the topography at the discharge area did not allow for the water to flow overland to a surface water location, consistent with discussions with VADEQ. The water in the SRA 4 excavation and the water in the frac tanks, however, could not be discharged without treatment. Treatment through the on-site treatment system of the amount of water in the tanks and excavation (estimated at over 200,000 gallons) would have required a significant amount of time to complete with the potential to impact the overall schedule for completion of soil IM work. Therefore, ARC elected to ship this water off-site for treatment.

Overall, 239,361 gallons of water were transported off-site for treatment/disposal (45 truckloads total). Water was shipped to both the Aqua Clean Environmental of Virginia LLC d/b/a Reco Biotechnology (RECO) facility in Richmond, Virginia (16 loads) and the Clean Venture facility in New Windsor, Maryland (29 loads) beginning April 4, 2013 and ending April 30, 2013. Copies of the bills of lading are included in Appendix P along with a truck log documenting all of the shipments.

3.7.7 Non-Metallic Debris, Scrap Metal and Tires

Tires, wood and non-metallic debris generated by excavation/screening activities were staged in the staging area across from Building 18 (aka, “Staging Area 18”). The wood was put aside and left on-site with other wood debris. Remnant, non-metallic debris from screening operations was disposed off-site as part of final site cleanup and demobilization. Twelve shipments were made in 2012, consisting of the 12 roll-offs of soil/debris from SRA 1 that were segregated due to observed soil color and odor. These shipments totaled 134.31 tons. In 2013, three additional shipments of debris, via end dumps, were made to remove remaining debris from the staging area, adding 41.17 more tons of off-site debris disposal. Appendix Q includes a summary table of these shipments as well as copies of the Bills of Lading for each shipment.

Excavation and screening of debris areas (primarily SRA 1 and SRA 2) exposed many waste tires. Tires ranged in size from passenger vehicle and light truck tires to oversized equipment tires. Residual soil was removed from the tires prior to shipment off-site. The tires were removed from the site by Commonwealth Recycled Aggregate for disposal at Fauquier County Landfill in Warrenton, Virginia. Appendix Q includes a summary table of the two shipments made as well as receipts for tire disposal.

A total of 11 roll-off containers of scrap metal were loaded and sent off site to Virginia Scrap. Explosives team personnel screened the scrap metal materials for MD/MEC prior to loading into the roll-off containers. Receipts for scrap metal shipments and other related documentation of scrap removal are included in Appendix Q.

4. Summary and Conclusions

ARC has completed soil IM activities at the facility located in Gainesville, Virginia. The soil IM activities were completed consistent with the *Soil IM Work Plan* (Geosyntec 2011) approved by USEPA on April 8, 2011.

The IM approach focused on areas that would likely require remediation by removal/treatment rather than using ICs/ ECs. As such, soil remediation included the removal of potentially hazardous buried debris and/or removal to mitigate potentially unacceptable soil exposure risks (i.e., cumulative cancer risks greater than 10^{-4} and/or noncancer HIs greater than 1 under a commercial/industrial land use scenario). A total of sixteen areas were identified as potentially requiring soil removal. Prior to implementing the soil removal for the identified soil IM areas, pre-removal sampling was conducted to fill data gaps and refine excavation limits.

Of the identified soil IM areas, six non-debris areas were eliminated from further assessment based upon an evaluation of the pre-excavation RME risks estimates. Soil interim measures (i.e., soil excavation) were therefore performed at the remaining identified soil IM areas. For non-debris areas, soil was excavated to the limits necessary (both vertically and laterally) to reduce risks to acceptable levels for continued commercial/industrial land use. For debris areas, the limits of excavation were determined by the buried debris present in the area, and were subsequently sampled to confirm that remaining soil concentrations met the risk goals for the soil IM program. Each excavated area was restored via backfilling, grading and hydroseeding.

As documented in this report, ARC achieved the objective of the soil IM program – all on-site areas of the site that had been initially identified as posing a potentially unacceptable risk via soil exposure associated with continued commercial/industrial land use have been successfully addressed. Further, as documented in the November 2012 *RCRA Facility Investigation Baseline Risk Assessment* (ENVIRON 2012), which reassessed potential site-specific human health risks based on all soil data outside of the designated soil IM areas, all current and future potential exposures for on- and off-site receptors to soil under commercial/industrial use are at or below USEPA's cumulative cancer risk and noncancer HI limits of 10^{-4} and 1, respectively. The baseline risk assessment did identify 117 soil sampling locations that potentially pose an unacceptable risk if the land use were to change in the future; specifically, the baseline risk assessment evaluated potential soil exposures associated with residential land use (see Figure 4-1). As shown on Figure 4-2, under residential land use, an estimated eight acres of the site would warrant further evaluation for corrective measures (e.g., remediation, and/or ICs/ECs). These areas are to be further evaluated in the corrective measures study to be prepared by ARC.

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Tables

Table 3-1: Pre-Excavation Reasonable Maximum[1,2] Cumulative Cancer Risks and HIs for Each Non-Debris/Surface Debris Soil IM Area ARC Gainesville, Gainesville, VA

Soil IM Areas	Area Type	USEPA RSL Based[3] Routine Worker Outdoor Activities		ENVIRON Construction Worker Redevel. Activities	
		Risk	HI	Risk	HI
IM-2 (7800-152 Area)	Surface Debris Area	3E-05	2E-01	2E-06	1E-01
SRA 4	Non-Debris Area	**2E-03**	**1E+02**	1E-04	**7E+01**
SRA 5	Non-Debris Area	**2E-03**	**1E+02**	1E-04	**7E+01**
SRA 6 (North)	Non-Debris Area	**5E-04**	**4E+01**	3E-05	**2E+01**
SRA 6[6] (South)	Non-Debris Area	1E-05	9E-01	8E-07	5E-01
SRA 8 (SR-40B Area)	Non-Debris Area	**1E-03**	**2E+00**	3E-06	**2E+01**
SRA 10[4] (B4AEC-1S Area)	Non-Debris Area	2E-07	6E-01	2E-08	1E+00
SRA 11[4] (B22AEC-1S Area)	Non-Debris Area	NC[7]	1E+00	NC[7]	**2E+00**
IM-3 (6450-2000 Area)	Non-Debris Area	5E-05	1E-01	3E-06	2E-01
IM-9 (3700-33 Area)	Surface Debris Area	1E-05	2E-01	7E-07	5E-01
IM-10 (3800-46 Area)	Surface Debris Area	5E-06	2E-01	4E-07	4E-01
SRA 9 (GPBG-02 Area)	Non-Debris Area	5E-06	8E-01	4E-07	**3E+00**
Notes:					

1. Cumulative cancer risk and HI estimates are based on the reasonable maximum exposure concentration for each chemical in the Soil IM Area. These risk estimates are the same as those presented on Table A2 of the Draft Soil IM Interim Report except that pre-excavation results are now included for SRA 10 and SRA 11, which were identified subsequent to the submittal of the Soil IM Work Plan.

2. Cumulative cancer risk and HI estimates in excess of 1E-4 and 1, respectively, are shaded gray and in bold. Cumulative cancer risk and HI estimates are calculated using site-related concentrations, which are those in excess of site-specific background for inorganics.

3. Cancer risks and noncancer HI estimates noted as "USEPA RSL Based" are based upon USEPA Regional Screening Levels (RSLs) (November 2011).

4. SRA 10 and 11 were identified subsequent to the submittal of the Soil IM Work Plan, beneath Buildings 22 and 4, respectively.

5. Risks and HIs presented above for IM-2 (7800-152 Area), IM-3 (6450-2000 Area), IM-9 (3700-33 Area), and IM-10 (3800-46 Area) represent upper-bound estimates rather than RMEs. RME risks were not computed for these areas since upper-bound risks were within USEPA acceptable risk range. They are included on this table for completeness.

6. Risks and HIs presented above for SRA 8 (SR-40B Area) represent upper-bound estimates rather than RMEs. RME risks were not computed for this area since the upper confidence limits (UCLs) for the chemicals were greater than their respective maximum concentrations.

7. NC - Risk estimates could not be calculated since either no toxicity value exists for the detected constituents in this area or no constituents were detected in this area.

Table 3-2: Post-Excavation Upper-Bound[1,2] Site-Related Cumulative Cancer Risks and Noncancer HIs for Each Soil IM Area
ARC Gainesville, Gainesville, VA

Soil IM Areas	Area Type	USEPA RSL Based[3]		ENVIRON	
		Routine Worker		Construction Worker	
		Outdoor Activities		Redevel. Activities	
		Risk	HI	Risk	HI
IM-10 (3800-46 Area)	Surface Debris Area	5E-06	2E-01	3E-07	4E-01
IM-2 (7800-152 Area)	Surface Debris Area	3E-05	2E-01	2E-06	1E-01
IM-3 (6450-2000 Area)	Non-Debris Area	5E-05	1E-01	3E-06	2E-01
IM-9 (3700-33 Area)	Surface Debris Area	1E-05	2E-01	7E-07	5E-01
SRA 1	Debris Area	7E-06	**2E+00**	1E-06	1E+00
SRA 10 (B4AEC-1S Area)	Non-Debris Area	2E-07	9E-02	2E-08	2E-01
SRA 11 (B22AEC-1S Area)	Non-Debris Area	NC[5]	4E-02	NC[5]	7E-02
SRA 2A[5]	Debris Area	6E-06	4E-01	4E-07	3E-01
SRA 2B[5]	Debris Area	2E-07	4E-01	2E-07	5E-01
SRA 3	Debris Area	2E-05	1E+00	1E-06	1E+00
SRA 4	Non-Debris Area	2E-05	1E+00	1E-06	9E-01
SRA 5	Non-Debris Area	2E-05	1E+00	1E-06	8E-01
SRA 6 (North)	Non-Debris Area	1E-05	7E-01	7E-07	5E-01
SRA 6 (South)	Non-Debris Area	3E-05	**2E+00**	2E-06	1E+00
SRA 7	Debris Area	4E-06	1E-01	3E-07	1E-01
SRA 8 (SR-40B Area)	Non-Debris Area	1E-07	2E-03	9E-10	2E-03
SRA 9 (GPBG-02 Area)	Non-Debris Area	5E-06	7E-01	4E-07	**3E+00**
Notes:					

1. Cumulative cancer risk and HI estimates are based on the highest exposure concentration for each chemical in the Soil IM Area.

2. Cumulative cancer risk and HI estimates in excess of 1E-4 and 1, respectively, are shaded gray and in bold. Cumulative cancer risk and HI estimates are calculated using site-related concentrations, which are those in excess of site-specific background for inorganics.

3. Cancer risks and noncancer HI estimates noted as "USEPA RSL Based" are based upon USEPA Regional Screening Levels (RSLs) (November 2011).

4. Since SRA 2A and SRA 2B (debris areas) are large in size (the sum of both areas is approximately 12 acres), the cumulative cancer risk and HI estimates are the maximum location-specific cumulative cancer risk and HI estimates for soil borings located within each SRA.

5. NC - Risk estimates could not be calculated since either no toxicity value exists for the detected constituents in this area or no constituents were detected in this area.

Table 3-3: Post-Excavation Reasonable Maximum[1,2] Cumulative Cancer Risks and HIs for Each Soil IM Area
ARC Gainesville, Gainesville, VA

Soil IM Areas	Area Type	USEPA RSL Based[3]		ENVIRON	
		Routine Worker		Construction Worker	
		Outdoor Activities		Redevel. Activities	
		Risk	HI	Risk	HI
IM-10 (3800-46 Area)	Surface Debris Area	5E-06	2E-01	3E-07	4E-01
IM-2 (7800-152 Area)	Surface Debris Area	3E-05	2E-01	2E-06	1E-01
IM-3 (6450-2000 Area)	Non-Debris Area	3E-05	1E-01	2E-06	2E-01
IM-9 (3700-33 Area)	Surface Debris Area	1E-05	2E-01	7E-07	5E-01
SRA 1	Debris Area	5E-06	7E-01	4E-07	1E+00
SRA 10 (B4AEC-1S Area)	Non-Debris Area	2E-07	9E-02	2E-08	2E-01
SRA 11 (B22AEC-1S Area)	Non-Debris Area	NC[7]	4E-02	NC[7]	7E-02
SRA 2A[6]	Debris Area	6E-06	4E-01	4E-07	3E-01
SRA 2B[6]	Debris Area	2E-07	4E-01	2E-07	5E-01
SRA 3	Debris Area	1E-05	6E-01	6E-07	7E-01
SRA 4	Non-Debris Area	4E-06	3E-01	3E-07	2E-01
SRA 5	Non-Debris Area	4E-06	3E-01	3E-07	2E-01
SRA 6 (North)	Non-Debris Area	5E-06	4E-01	3E-07	3E-01
SRA 6 (South)	Non-Debris Area	1E-05	8E-01	8E-07	6E-01
SRA 7	Debris Area	4E-06	1E-01	3E-07	1E-01
SRA 8 (SR-40B Area)	Non-Debris Area	1E-07	2E-03	9E-10	2E-03
SRA 9 (GPBG-02 Area)	Non-Debris Area	5E-06	4E-01	4E-07	1E+00
Notes:					

1. Cumulative cancer risk and HI estimates are based on the reasonable maximum exposure concentration for each chemical in the Soil IM Area.

2. No cumulative cancer risk and HI estimates are in excess of 1E-4 and 1, respectively. Cumulative cancer risk and HI estimates are calculated using site-related concentrations, which are those in excess of site-specific background for inorganics.

3. Cancer risks and noncancer HI estimates noted as "USEPA RSL Based" are based upon USEPA Regional Screening Levels (RSLs) (November 2011).

4. Cumulative cancer risk and HI estimates are calculated using site-related concentrations, which are those in excess of site-specific background for inorganics.

5. Risks and HIs presented above for IM-2 (7800-152 Area), IM-9 (3700-33 Area), IM-10 (3800-46 Area), SRA 7, SRA 8, SRA 10, and SRA 11 represent upper-bound estimates rather than RMEs. RME risks were not computed for these areas since upper-bound risks were within USEPA acceptable risk range. They are included on this table for convenience.

6. Since SRA 2A and SRA 2B (debris areas) are large in size (the sum of both areas is approximately 12 acres), the cumulative cancer risk and HI estimates are the maximum location-specific cumulative cancer risk and HI estimates for soil borings located within each SRA.

7. NC - Risk estimates could not be calculated since either no toxicity value exists for the detected constituents in this area or no constituents were detected in this area.

Table 3-4: Pre-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Non-Debris/Surface Debris Soil IM Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area[2]	Area Type	Location	Risk	HI	Risk	HI
Landbay A	IM-10 (3800-46 Area)	Surface Debris Area	3800-19	NC	9E-06	NC	2E-05
Landbay A	IM-10 (3800-46 Area)	Surface Debris Area	IM10-1	5E-06	2E-01	3E-07	4E-01
Landbay A	IM-10 (3800-46 Area)	Surface Debris Area	IM10-2	6E-07	4E-02	4E-08	1E-01
Landbay A	IM-10 (3800-46 Area)	Surface Debris Area	IM10-3	1E-10	1E-02	3E-10	5E-02
Landbay A	IM-10 (3800-46 Area)	Surface Debris Area	IM10-4	4E-08	1E-02	4E-09	5E-02
Landbay A	IM-10 (3800-46 Area)	Surface Debris Area	IM10-5	4E-08	3E-02	4E-09	8E-02
Landbay A	IM-9 (3700-33 Area)	Surface Debris Area	3750-3200	3E-08	1E-02	2E-09	6E-02
Landbay A	IM-9 (3700-33 Area)	Surface Debris Area	IM9-1	7E-06	2E-01	5E-07	4E-01
Landbay A	IM-9 (3700-33 Area)	Surface Debris Area	IM9-2	1E-05	4E-02	6E-07	1E-01
Landbay A	IM-9 (3700-33 Area)	Surface Debris Area	IM9-3	2E-10	2E-02	5E-10	6E-02
Landbay A	IM-9 (3700-33 Area)	Surface Debris Area	IM9-4	1E-08	1E-01	3E-08	2E-01
Landbay A	IM-9 (3700-33 Area)	Surface Debris Area	IM9-5	1E-07	2E-02	2E-08	5E-02
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	6800-118	NC	NC	NC	NC
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	6900-3350	2E-07	2E-03	2E-08	1E-03
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-1	5E-06	3E-01	4E-07	2E-01
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-10	1E-08	1E-01	3E-08	5E-01
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-2	1E-08	6E-01	3E-08	**3E+00**
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-3	3E-07	2E-01	2E-08	7E-01
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-4	2E-07	2E-01	2E-08	1E+00
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-5	1E-06	3E-01	1E-07	1E+00
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-6	NC	NC	NC	NC
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-7	NC	NC	NC	NC
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-8	2E-08	1E+00	6E-08	**6E+00**
Landbay B	SRA 9 (GPBG-02 Area)	Non-Debris Area	IM11-9	4E-09	1E-01	1E-08	6E-01
Landbay C	IM-3 (6450-2000 Area)	Non-Debris Area	6450-2000	5E-05	8E-02	3E-06	9E-02
Landbay C	IM-3 (6450-2000 Area)	Non-Debris Area	6450-2000N	NC	NC	NC	NC
Landbay C	IM-3 (6450-2000 Area)	Non-Debris Area	6450-2000SE	3E-05	4E-03	2E-06	1E-03
Landbay C	IM-3 (6450-2000 Area)	Non-Debris Area	6450-2000SW	NC	NC	NC	NC
Landbay C	IM-3 (6450-2000 Area)	Non-Debris Area	IM13-1	2E-08	6E-02	3E-09	2E-01
Landbay C	IM-3 (6450-2000 Area)	Non-Debris Area	IM13-2	7E-07	6E-02	6E-08	2E-01
Landbay C	IM-3 (6450-2000 Area)	Non-Debris Area	IM13-3	6E-11	1E-02	2E-10	5E-02
Landbay C	IM-3 (6450-2000 Area)	Non-Debris Area	IM13-4	2E-08	6E-02	3E-09	2E-01
Landbay C	IM-3 (6450-2000 Area)	Non-Debris Area	IM13-5	4E-10	3E-02	9E-10	1E-01
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	22B1	2E-07	2E-03	2E-08	4E-03
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	22B2	2E-07	2E-03	2E-08	4E-03
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	22B3	2E-07	2E-03	2E-08	4E-03

Table 3-4: Pre-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Non-Debris/Surface Debris Soil IM Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area[2]	Area Type	Location	Risk	HI	Risk	HI
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	22B4	2E-07	4E-03	2E-08	5E-03
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	22B7	2E-11	2E-05	2E-12	4E-05
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	22G5	NC	2E-02	NC	3E-02
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	22G6	NC	1E-02	NC	2E-02
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	B22AEC-1S	NC	1E+00	NC	**3E+00**
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	GP 22-03	NC	NC	NC	NC
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	GP 22-04	NC	NC	NC	NC
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	GP 22-05	NC	NC	NC	NC
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-1	NC	3E-06	NC	6E-06
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-10	NC	5E-07	NC	1E-06
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-11	NC	3E-06	NC	7E-06
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-2	NC	8E-04	NC	2E-03
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-3	NC	1E-04	NC	2E-04
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-4	NC	3E-06	NC	5E-06
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-5	NC	3E-05	NC	5E-05
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-6	NC	3E-05	NC	6E-05
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-7	NC	8E-02	NC	2E-01
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-8	NC	3E-03	NC	5E-03
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SRA10-9	NC	9E-07	NC	2E-06
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SS-22A	NC	2E-05	NC	3E-05
Landbay D	SRA 10 (B4AEC-1S Area)	Non-Debris Area	SW 9-01	NC	NC	NC	NC
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	4B1	NC	2E-06	NC	5E-06
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	B4AEC-1S	NC	2E+00	NC	**4E+00**
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	GP 4-03	NC	NC	NC	NC
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SR-4S	NC	NC	NC	NC
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SRA11-1	NC	4E-05	NC	7E-05
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SRA11-2	NC	1E-02	NC	2E-02
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SRA11-3	NC	3E-02	NC	6E-02
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SRA11-4	NC	1E-04	NC	2E-04
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SRA11-5	NC	2E-04	NC	4E-04
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SRA11-6	NC	5E-03	NC	1E-02
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SRA11-7	NC	4E-02	NC	7E-02
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SRA11-8	NC	4E-05	NC	9E-05
Landbay D	SRA 11 (B22AEC-1S Area)	Non-Debris Area	SW 6-01	NC	NC	NC	NC
Landbay D	SRA 4	Non-Debris Area	42 GP-03	3E-07	2E-02	2E-08	1E-02
Landbay D	SRA 4	Non-Debris Area	42 GP-04	2E-07	1E-02	1E-08	8E-03

Table 3-4: Pre-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Non-Debris/Surface Debris Soil IM Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area[2]	Area Type	Location	Risk	HI	Risk	HI
Landbay D	SRA 4	Non-Debris Area	42 GP-16	4E-06	3E-01	3E-07	2E-01
Landbay D	SRA 4	Non-Debris Area	42 GP-17	3E-07	2E-02	2E-08	1E-02
Landbay D	SRA 4	Non-Debris Area	42 GP-25	1E-05	8E-01	7E-07	5E-01
Landbay D	SRA 4	Non-Debris Area	42 GP-26	2E-07	1E-02	1E-08	7E-03
Landbay D	SRA 4	Non-Debris Area	42 GP-32	7E-03	4E+02	**4E-04**	**3E+02**
Landbay D	SRA 4	Non-Debris Area	42 GP-33	4E-06	2E-01	2E-07	1E-01
Landbay D	SRA 4	Non-Debris Area	42 GP-34	3E-08	2E-03	2E-09	1E-03
Landbay D	SRA 4	Non-Debris Area	42 GP-35	1E-05	6E-01	6E-07	4E-01
Landbay D	SRA 4	Non-Debris Area	42B133	9E-08	6E-03	6E-09	4E-03
Landbay D	SRA 4	Non-Debris Area	42B134	4E-08	2E-03	2E-09	1E-03
Landbay D	SRA 4	Non-Debris Area	43B131	4E-04	3E+01	3E-05	**2E+01**
Landbay D	SRA 4	Non-Debris Area	43B132	5E-07	3E-02	3E-08	2E-02
Landbay D	SRA 4	Non-Debris Area	43G113	8E-07	6E-02	5E-08	4E-02
Landbay D	SRA 4	Non-Debris Area	43G121	7E-08	5E-03	4E-09	3E-03
Landbay D	SRA 4	Non-Debris Area	43G122	1E-05	8E-01	7E-07	5E-01
Landbay D	SRA 4	Non-Debris Area	43G123	3E-08	2E-03	2E-09	1E-03
Landbay D	SRA 4	Non-Debris Area	43G124	3E-06	2E-01	2E-07	1E-01
Landbay D	SRA 4	Non-Debris Area	43G125	5E-06	3E-01	3E-07	2E-01
Landbay D	SRA 4	Non-Debris Area	43G127	5E-06	4E-01	3E-07	2E-01
Landbay D	SRA 4	Non-Debris Area	43G128	4E-05	3E+00	3E-06	**2E+00**
Landbay D	SRA 4	Non-Debris Area	43G129	6E-08	4E-03	4E-09	3E-03
Landbay D	SRA 4	Non-Debris Area	43G130	5E-06	4E-01	3E-07	2E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-1	5E-07	3E-02	3E-08	2E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-10	8E-06	5E-01	5E-07	3E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-11	NC	NC	NC	NC
Landbay D	SRA 4	Non-Debris Area	SRA4-12	NC	NC	NC	NC
Landbay D	SRA 4	Non-Debris Area	SRA4-13	4E-03	3E+02	**2E-04**	**2E+02**
Landbay D	SRA 4	Non-Debris Area	SRA4-14	2E-03	2E+02	**2E-04**	**1E+02**
Landbay D	SRA 4	Non-Debris Area	SRA4-14A	1E-06	8E-02	7E-08	5E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-15	3E-03	2E+02	**2E-04**	**1E+02**
Landbay D	SRA 4	Non-Debris Area	SRA4-16	4E-05	2E+00	2E-06	**2E+00**
Landbay D	SRA 4	Non-Debris Area	SRA4-17	2E-07	1E-02	1E-08	6E-03
Landbay D	SRA 4	Non-Debris Area	SRA4-18	1E-06	8E-02	7E-08	5E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-19	9E-06	6E-01	6E-07	4E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-2	1E-05	7E-01	6E-07	4E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-20	6E-06	4E-01	4E-07	2E-01

Table 3-4: Pre-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Non-Debris/Surface Debris Soil IM Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area[2]	Area Type	Location	Risk	HI	Risk	HI
Landbay D	SRA 4	Non-Debris Area	SRA4-21	NC	NC	NC	NC
Landbay D	SRA 4	Non-Debris Area	SRA4-22	NC	NC	NC	NC
Landbay D	SRA 4	Non-Debris Area	SRA4-23	3E-05	2E+00	2E-06	1E+00
Landbay D	SRA 4	Non-Debris Area	SRA4-24	1E-07	9E-03	8E-09	6E-03
Landbay D	SRA 4	Non-Debris Area	SRA4-25	1E-05	9E-01	8E-07	6E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-26	2E-04	1E+01	1E-05	**7E+00**
Landbay D	SRA 4	Non-Debris Area	SRA4-27	2E-06	1E-01	1E-07	7E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-28	1E-04	7E+00	7E-06	**4E+00**
Landbay D	SRA 4	Non-Debris Area	SRA4-29	4E-06	3E-01	3E-07	2E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-3	2E-05	1E+00	1E-06	9E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-30	2E-05	1E+00	1E-06	8E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-31	3E-05	2E+00	2E-06	1E+00
Landbay D	SRA 4	Non-Debris Area	SRA4-32	7E-06	5E-01	5E-07	3E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-33	2E-06	1E-01	1E-07	6E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-34	2E-05	1E+00	1E-06	8E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-35	4E-05	2E+00	2E-06	**2E+00**
Landbay D	SRA 4	Non-Debris Area	SRA4-36	1E-07	1E-02	9E-09	6E-03
Landbay D	SRA 4	Non-Debris Area	SRA4-37	3E-05	2E+00	2E-06	1E+00
Landbay D	SRA 4	Non-Debris Area	SRA4-37A	1E-06	7E-02	6E-08	4E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-38	5E-06	4E-01	3E-07	2E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-39	8E-06	5E-01	5E-07	3E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-4	3E-07	2E-02	2E-08	1E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-40	8E-04	5E+01	5E-05	**3E+01**
Landbay D	SRA 4	Non-Debris Area	SRA4-40A	1E-03	9E+01	9E-05	**6E+01**
Landbay D	SRA 4	Non-Debris Area	SRA4-41	6E-05	4E+00	4E-06	**3E+00**
Landbay D	SRA 4	Non-Debris Area	SRA4-41A	1E-03	7E+01	6E-05	**4E+01**
Landbay D	SRA 4	Non-Debris Area	SRA4-42	1E-03	7E+01	6E-05	**4E+01**
Landbay D	SRA 4	Non-Debris Area	SRA4-42A	9E-08	6E-03	6E-09	4E-03
Landbay D	SRA 4	Non-Debris Area	SRA4-43	3E-04	2E+01	2E-05	**1E+01**
Landbay D	SRA 4	Non-Debris Area	SRA4-43A	3E-06	2E-01	2E-07	1E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-44	1E-06	8E-02	8E-08	5E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-44A	1E-07	8E-03	8E-09	5E-03
Landbay D	SRA 4	Non-Debris Area	SRA4-45	3E-06	2E-01	2E-07	1E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-46	1E-07	7E-03	7E-09	4E-03
Landbay D	SRA 4	Non-Debris Area	SRA4-5	1E-05	1E+00	9E-07	6E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-6	7E-04	5E+01	4E-05	**3E+01**

Table 3-4: Pre-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Non-Debris/Surface Debris Soil IM Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area[2]	Area Type	Location	Risk	HI	Risk	HI
Landbay D	SRA 4	Non-Debris Area	SRA4-8	7E-05	5E+00	4E-06	**3E+00**
Landbay D	SRA 4	Non-Debris Area	SRA4-9	9E-07	6E-02	6E-08	4E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-B1	1E-05	9E-01	9E-07	6E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-B2	1E-06	7E-02	7E-08	5E-02
Landbay D	SRA 4	Non-Debris Area	SRA4-B3	7E-06	5E-01	5E-07	3E-01
Landbay D	SRA 4	Non-Debris Area	SRA4-B4	5E-04	3E+01	3E-05	**2E+01**
Landbay D	SRA 4	Non-Debris Area	SS-43A	NC	9E-06	NC	2E-05
Landbay D	SRA 5	Non-Debris Area	15 GP-01	1E-07	8E-03	7E-09	5E-03
Landbay D	SRA 5	Non-Debris Area	15 GP-02	8E-03	5E+02	**5E-04**	**3E+02**
Landbay D	SRA 5	Non-Debris Area	15 GP-03	1E-06	1E-01	9E-08	6E-02
Landbay D	SRA 5	Non-Debris Area	15 GP-04	2E-05	1E+00	1E-06	7E-01
Landbay D	SRA 5	Non-Debris Area	15 GP-05	3E-06	2E-01	2E-07	1E-01
Landbay D	SRA 5	Non-Debris Area	15 GP-17	4E-05	2E+00	2E-06	**2E+00**
Landbay D	SRA 5	Non-Debris Area	15 GP-18	7E-06	4E-01	4E-07	3E-01
Landbay D	SRA 5	Non-Debris Area	15 GP-19	4E-07	3E-02	3E-08	2E-02
Landbay D	SRA 5	Non-Debris Area	15 GP-20	1E-07	9E-03	8E-09	6E-03
Landbay D	SRA 5	Non-Debris Area	15 GP-21	3E-06	2E-01	2E-07	1E-01
Landbay D	SRA 5	Non-Debris Area	15 GP-29	4E-08	3E-03	2E-09	2E-03
Landbay D	SRA 5	Non-Debris Area	15 GP-30	NC	NC	NC	NC
Landbay D	SRA 5	Non-Debris Area	15 GP-31	3E-05	2E+00	2E-06	1E+00
Landbay D	SRA 5	Non-Debris Area	15AEC-1	3E-07	1E-01	2E-08	2E-01
Landbay D	SRA 5	Non-Debris Area	15ANEC	NC	2E-03	NC	4E-03
Landbay D	SRA 5	Non-Debris Area	5B1	1E-04	5E+00	7E-06	**3E+00**
Landbay D	SRA 5	Non-Debris Area	5B3	4E-08	2E-02	4E-09	8E-02
Landbay D	SRA 5	Non-Debris Area	5B4	6E-08	3E-02	5E-09	8E-02
Landbay D	SRA 5	Non-Debris Area	5B6	4E-09	7E-03	8E-10	3E-02
Landbay D	SRA 5	Non-Debris Area	5G5	8E-08	8E-04	5E-09	2E-04
Landbay D	SRA 5	Non-Debris Area	BW 5-06	NC	NC	NC	NC
Landbay D	SRA 5	Non-Debris Area	GP 15-01	NC	NC	NC	NC
Landbay D	SRA 5	Non-Debris Area	GP 15-03	NC	NC	NC	NC
Landbay D	SRA 5	Non-Debris Area	HA 15-01	NC	NC	NC	NC
Landbay D	SRA 5	Non-Debris Area	IM8-1	6E-06	4E-01	4E-07	2E-01
Landbay D	SRA 5	Non-Debris Area	IM8-2	3E-08	2E-03	2E-09	1E-03
Landbay D	SRA 5	Non-Debris Area	IM8-3	3E-08	2E-03	2E-09	1E-03
Landbay D	SRA 5	Non-Debris Area	IM8-4	5E-07	3E-02	3E-08	2E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-1	5E-06	3E-01	3E-07	2E-01

Table 3-4: Pre-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Non-Debris/Surface Debris Soil IM Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area[2]	Area Type	Location	Risk	HI	Risk	HI
Landbay D	SRA 5	Non-Debris Area	SRA5-10	1E-06	7E-02	7E-08	5E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-11	4E-07	3E-02	3E-08	2E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-12	1E-04	9E+00	9E-06	**6E+00**
Landbay D	SRA 5	Non-Debris Area	SRA5-13	9E-06	6E-01	6E-07	4E-01
Landbay D	SRA 5	Non-Debris Area	SRA5-14	3E-05	2E+00	2E-06	1E+00
Landbay D	SRA 5	Non-Debris Area	SRA5-15	5E-04	3E+01	3E-05	**2E+01**
Landbay D	SRA 5	Non-Debris Area	SRA5-16	7E-07	5E-02	5E-08	3E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-17	1E-04	1E+01	9E-06	**6E+00**
Landbay D	SRA 5	Non-Debris Area	SRA5-18	4E-05	3E+00	3E-06	**2E+00**
Landbay D	SRA 5	Non-Debris Area	SRA5-19	4E-06	3E-01	3E-07	2E-01
Landbay D	SRA 5	Non-Debris Area	SRA5-2	2E-07	1E-02	1E-08	7E-03
Landbay D	SRA 5	Non-Debris Area	SRA5-20	8E-07	5E-02	5E-08	3E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-21	4E-06	3E-01	2E-07	2E-01
Landbay D	SRA 5	Non-Debris Area	SRA5-22	7E-06	5E-01	4E-07	3E-01
Landbay D	SRA 5	Non-Debris Area	SRA5-23	7E-06	5E-01	4E-07	3E-01
Landbay D	SRA 5	Non-Debris Area	SRA5-24	9E-04	6E+01	5E-05	**4E+01**
Landbay D	SRA 5	Non-Debris Area	SRA5-25	4E-08	3E-03	2E-09	2E-03
Landbay D	SRA 5	Non-Debris Area	SRA5-26	5E-08	4E-03	3E-09	2E-03
Landbay D	SRA 5	Non-Debris Area	SRA5-27	1E-06	8E-02	8E-08	5E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-28	1E-05	7E-01	7E-07	4E-01
Landbay D	SRA 5	Non-Debris Area	SRA5-29	5E-05	3E+00	3E-06	**2E+00**
Landbay D	SRA 5	Non-Debris Area	SRA5-3	2E-06	1E-01	1E-07	7E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-30	1E-06	7E-02	6E-08	4E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-31	6E-08	4E-03	4E-09	2E-03
Landbay D	SRA 5	Non-Debris Area	SRA5-32	1E-07	7E-03	7E-09	5E-03
Landbay D	SRA 5	Non-Debris Area	SRA5-33	1E-03	8E+01	7E-05	**5E+01**
Landbay D	SRA 5	Non-Debris Area	SRA5-34	9E-06	6E-01	6E-07	4E-01
Landbay D	SRA 5	Non-Debris Area	SRA5-35	3E-05	2E+00	2E-06	1E+00
Landbay D	SRA 5	Non-Debris Area	SRA5-36	2E-06	1E-01	1E-07	7E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-39	1E-06	9E-02	6E-08	9E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-4	2E-04	2E+01	1E-05	**1E+01**
Landbay D	SRA 5	Non-Debris Area	SRA5-40	2E-06	1E-01	1E-07	8E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-41	3E-05	2E+00	2E-06	1E+00
Landbay D	SRA 5	Non-Debris Area	SRA5-41A	2E-10	5E-06	2E-11	9E-06
Landbay D	SRA 5	Non-Debris Area	SRA5-42	2E-03	1E+02	1E-04	**9E+01**
Landbay D	SRA 5	Non-Debris Area	SRA5-42A	3E-07	2E-02	2E-08	1E-02

Table 3-4: Pre-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Non-Debris/Surface Debris Soil IM Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area[2]	Area Type	Location	Risk	HI	Risk	HI
Landbay D	SRA 5	Non-Debris Area	SRA5-43	1E-04	7E+00	6E-06	**4E+00**
Landbay D	SRA 5	Non-Debris Area	SRA5-43A	8E-07	5E-02	5E-08	3E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-44	2E-03	1E+02	1E-04	**7E+01**
Landbay D	SRA 5	Non-Debris Area	SRA5-45	4E-07	3E-02	3E-08	2E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-46	6E-07	4E-02	4E-08	3E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-47	3E-07	2E-02	2E-08	2E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-5	6E-08	4E-03	4E-09	3E-03
Landbay D	SRA 5	Non-Debris Area	SRA5-6	2E-06	1E-01	1E-07	7E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-7	NC	NC	NC	NC
Landbay D	SRA 5	Non-Debris Area	SRA5-8	4E-07	3E-02	3E-08	2E-02
Landbay D	SRA 5	Non-Debris Area	SRA5-9	NC	NC	NC	NC
Landbay D	SRA 5	Non-Debris Area	SS-08A	1E-07	2E-03	1E-08	5E-03
Landbay D	SRA 5	Non-Debris Area	SW 15-01	NC	NC	NC	NC
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-11	1E-06	8E-02	7E-08	5E-02
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-12	7E-08	5E-03	5E-09	3E-03
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-13	2E-05	1E+00	1E-06	7E-01
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-14	4E-08	3E-03	2E-09	2E-03
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-15	1E-03	8E+01	8E-05	**5E+01**
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-16	7E-08	5E-03	5E-09	3E-03
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-24	NC	NC	NC	NC
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-25	4E-07	3E-02	2E-08	2E-02
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-26	6E-08	4E-03	4E-09	3E-03
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-27	7E-08	5E-03	5E-09	3E-03
Landbay D	SRA 6 (North)	Non-Debris Area	15 GP-28	1E-04	9E+00	9E-06	**6E+00**
Landbay D	SRA 6 (North)	Non-Debris Area	2 GP-01	4E-08	2E-03	2E-09	1E-03
Landbay D	SRA 6 (North)	Non-Debris Area	2 GP-02	1E-05	7E-01	7E-07	5E-01
Landbay D	SRA 6 (North)	Non-Debris Area	2 GP-10	6E-07	4E-02	4E-08	3E-02
Landbay D	SRA 6 (North)	Non-Debris Area	2 GP-18	7E-08	5E-03	4E-09	3E-03
Landbay D	SRA 6 (North)	Non-Debris Area	2 GP-19	NC	NC	NC	NC
Landbay D	SRA 6 (North)	Non-Debris Area	2 GP-20	7E-07	5E-02	4E-08	3E-02
Landbay D	SRA 6 (North)	Non-Debris Area	2 GP-21	6E-07	4E-02	4E-08	2E-02
Landbay D	SRA 6 (North)	Non-Debris Area	2 GP-22	NC	NC	NC	NC
Landbay D	SRA 6 (North)	Non-Debris Area	2B1	2E-09	1E-02	1E-10	4E-02
Landbay D	SRA 6 (north)	Non-Debris Area	BW 21-03	NC	NC	NC	NC
Landbay D	SRA 6 (north)	Non-Debris Area	BW 21-04	NC	NC	NC	NC
Landbay D	SRA 6 (north)	Non-Debris Area	GP 1-02	NC	NC	NC	NC

Table 3-4: Pre-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Non-Debris/Surface Debris Soil IM Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area[2]	Area Type	Location	Risk	HI	Risk	HI
Landbay D	SRA 6 (north)	Non-Debris Area	GP 1-03	NC	NC	NC	NC
Landbay D	SRA 6 (North)	Non-Debris Area	GP 3-02	NC	5E-05	NC	1E-04
Landbay D	SRA 6 (north)	Non-Debris Area	GP 4-01	NC	7E-05	NC	1E-04
Landbay D	SRA 6 (north)	Non-Debris Area	SB 2-01	NC	NC	NC	NC
Landbay D	SRA 6 (North)	Non-Debris Area	SRA6-1	7E-08	5E-03	4E-09	3E-03
Landbay D	SRA 6 (North)	Non-Debris Area	SRA6-11	2E-07	1E-02	1E-08	9E-03
Landbay D	SRA 6 (North)	Non-Debris Area	SRA6-12	2E-06	1E-01	1E-07	8E-02
Landbay D	SRA 6 (North)	Non-Debris Area	SRA6-2	3E-07	2E-02	2E-08	1E-02
Landbay D	SRA 6 (North)	Non-Debris Area	SRA6-3	2E-07	1E-02	1E-08	9E-03
Landbay D	SRA 6 (North)	Non-Debris Area	SRA6-4	2E-06	1E-01	1E-07	8E-02
Landbay D	SRA 6 (North)	Non-Debris Area	SRA6-5	3E-06	2E-01	2E-07	1E-01
Landbay D	SRA 6 (North)	Non-Debris Area	SRA6-6	3E-07	2E-02	2E-08	1E-02
Landbay D	SRA 6 (North)	Non-Debris Area	SRA6-7	6E-07	4E-02	4E-08	3E-02
Landbay D	SRA 6 (North)	Non-Debris Area	SW 21-01	NC	3E-05	NC	7E-05
Landbay D	SRA 6 (north)	Non-Debris Area	SW 5-02	NC	NC	NC	NC
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-04	NC	NC	NC	NC
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-05	4E-06	3E-01	3E-07	2E-01
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-06	5E-06	3E-01	3E-07	2E-01
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-07	6E-07	4E-02	4E-08	2E-02
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-08	2E-06	1E-01	1E-07	7E-02
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-09	3E-05	2E+00	2E-06	1E+00
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-13	2E-07	1E-02	1E-08	7E-03
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-14	NC	NC	NC	NC
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-15	1E-07	7E-03	6E-09	4E-03
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-16	3E-07	2E-02	2E-08	1E-02
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-17	4E-06	3E-01	3E-07	2E-01
Landbay D	SRA 6 (South)	Non-Debris Area	2 GP-25	NC	NC	NC	NC
Landbay D	SRA 6 (South)	Non-Debris Area	2 SED-01	9E-07	6E-02	7E-08	1E-01
Landbay D	SRA 6 (South)	Non-Debris Area	SRA6-10	4E-06	3E-01	3E-07	2E-01
Landbay D	SRA 6 (South)	Non-Debris Area	SRA6-8	5E-08	4E-03	3E-09	2E-03
Landbay D	SRA 6 (South)	Non-Debris Area	SRA6-9	5E-07	3E-02	3E-08	2E-02
Landbay E	IM-2 (7800-152 Area)	Surface Debris Area	7800-1100	NC	NC	NC	NC
Landbay E	IM-2 (7800-152 Area)	Surface Debris Area	IM12-1	3E-05	2E-01	2E-06	1E-01
Landbay E	IM-2 (7800-152 Area)	Surface Debris Area	IM12-2	7E-07	5E-03	5E-08	4E-03
Landbay E	IM-2 (7800-152 Area)	Surface Debris Area	IM12-3	6E-06	4E-02	4E-07	1E-02
Landbay E	IM-2 (7800-152 Area)	Surface Debris Area	IM12-4	7E-11	4E-04	2E-10	2E-03

Table 3-4: Pre-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Non-Debris/Surface Debris Soil IM Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area[2]	Area Type	Location	Risk	HI	Risk	HI
Landbay E	IM-2 (7800-152 Area)	Surface Debris Area	IM12-5	3E-06	2E-02	2E-07	7E-03
Landbay E	SRA 8 (SR-40B Area)	Non-Debris Area	GP 40-04	NC	NC	NC	NC
Landbay E	SRA 8 (SR-40B Area)	Non-Debris Area	IM14-1	NC	2E-06	NC	2E-06
Landbay E	SRA 8 (SR-40B Area)	Non-Debris Area	IM14-2	3E-05	8E+00	3E-06	**2E+01**
Landbay E	SRA 8 (SR-40B Area)	Non-Debris Area	IM14-3	2E-09	2E-05	2E-10	4E-05
Landbay E	SRA 8 (SR-40B Area)	Non-Debris Area	IM14-4	3E-09	4E-05	3E-10	7E-05
Landbay E	SRA 8 (SR-40B Area)	Non-Debris Area	IM14-5	9E-09	2E-03	8E-10	2E-03
Landbay E	SRA 8 (SR-40B Area)	Non-Debris Area	IM14-6	NC	3E-06	NC	9E-06
Landbay E	SRA 8 (SR-40B Area)	Non-Debris Area	IM14-7	1E-09	4E-04	1E-10	7E-04

Notes:

1. Landbay Use Designation:
   - Landbay A - industrial/commercial use
   - Landbay B - mixed use
   - Landbay C - industrial/commercial use
   - Landbay D - residential use
   - Landbay E - residential use
2. Only locations associated with a non-debris or surface debris Soil IM Area are shown.
3. Cumulative cancer risk and HI estimates in excess of 1E-4 and 1, respectively, are shaded gray and in bold font. Cumulative cancer risk and HI estimates in excess of 1E-2 and 100, respectively, are shaded red and in bold font.
4. Cumulative cancer risk and HI estimates are based on the highest concentration for each chemical at each location.
5. Cumulative cancer risk and HI estimates are calculated using site-related concentrations, which are those in excess of site-specific background for inorganics.
6. NC - risk estimates could not be calculated since either no toxicity value exists for the detected constituents at this location or no constituents were detected at this location.

Table 3-5: Post-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Test Pit Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	Soil IM Area	Area Type	Location	Risk	HI	Risk	HI
Landbay A	SRA 1	Debris Area	SRA1-TPA10-BASE1	5E-08	1E-02	4E-09	2E-02
Landbay A	SRA 1	Debris Area	SRA1-TPA10-BASE2[6]	4E-06	**2E+00**	8E-07	6E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA10-BASE3	3E-12	9E-03	9E-12	2E-02
Landbay A	SRA 1	Debris Area	SRA1-TPA10-SIDE1	3E-07	2E-01	8E-08	5E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA10-SIDE2	4E-08	8E-03	3E-09	1E-02
Landbay A	SRA 1	Debris Area	SRA1-TPA10-SIDE3	4E-07	3E-02	2E-08	3E-02
Landbay A	SRA 1	Debris Area	SRA1-TPA11-BASE1	3E-07	6E-02	2E-08	1E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA11-BASE2	1E-06	9E-02	9E-08	6E-02
Landbay A	SRA 1	Debris Area	SRA1-TPA11-BASE3	6E-06	4E-01	4E-07	3E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA11-SIDE1	2E-07	2E-02	2E-08	1E-02
Landbay A	SRA 1	Debris Area	SRA1-TPA11-SIDE2	6E-06	4E-01	4E-07	4E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA11-SIDE3	1E-06	1E-01	6E-08	2E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA11-SIDE4	2E-07	5E-02	1E-08	1E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA12-BASE1	3E-06	1E-01	2E-07	2E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA12-SIDE1	2E-06	9E-02	2E-07	2E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA4-BASE1	2E-07	4E-02	1E-08	1E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA4-SIDE1	1E-06	9E-02	8E-08	9E-02
Landbay A	SRA 1	Debris Area	SRA1-TPA5-BASE1	7E-08	1E-02	5E-09	3E-02
Landbay A	SRA 1	Debris Area	SRA1-TPA5-SIDE1	2E-06	4E-02	1E-07	1E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA6-BASE1	3E-06	7E-02	2E-07	1E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA6-SIDE1	1E-06	4E-02	7E-08	5E-02
Landbay A	SRA 1	Debris Area	SRA1-TPA7-BASE1	6E-09	7E-02	2E-09	3E-01
Landbay A	SRA 1	Debris Area	SRA1-TPA7-SIDE1	3E-06	1E-01	2E-07	9E-02
Landbay A	SRA 2A	Debris Area	TPB11-SIDE1	3E-08	1E-02	3E-09	3E-02
Landbay A	SRA 2A	Debris Area	TPB11-SIDE2	2E-06	9E-02	1E-07	9E-02
Landbay A	SRA 2A	Debris Area	TPB11-SIDE3	1E-07	4E-03	1E-08	6E-03
Landbay A	SRA 2A	Debris Area	TPB11-SIDE4	6E-07	6E-02	4E-08	8E-02
Landbay A	SRA 2A	Debris Area	TPB12-SIDE1	9E-08	1E-02	6E-09	2E-02
Landbay A	SRA 2A	Debris Area	TPB12-SIDE2	1E-07	4E-02	9E-09	8E-02
Landbay A	SRA 2A	Debris Area	TPB12-SIDE3	5E-06	3E-01	3E-07	3E-01
Landbay A	SRA 2A	Debris Area	TPB12-SIDE4	3E-06	2E-01	2E-07	2E-01
Landbay A	SRA 2B	Debris Area	SRA2-TPB8-BASE1	6E-08	8E-03	4E-09	2E-02
Landbay A	SRA 2B	Debris Area	SRA2-TPB8-SIDE1	1E-06	8E-02	7E-08	9E-02

Table 3-5: Post-Excavation Upper-Bound Location-Specific Site-Related Cumulative Cancer Risks and Noncancer HIs for Soil (Test Pit Areas)
ARC Gainesville, Gainesville, Virginia

				USEPA RSL Based		ENVIRON	
				Routine Worker		Construction Worker	
				Outdoor Activities		Redevel. Activities	
Landbay[1]	**Soil IM Area**	**Area Type**	**Location**	Risk	HI	Risk	HI
Landbay A	SRA 2B	Debris Area	TP-B15-4	2E-07	3E-02	1E-08	6E-02
Landbay A	SRA 2B	Debris Area	TP-B16-3	1E-06	1E-01	9E-08	2E-01
Landbay A	SRA 2B	Debris Area	TP-B17-3	1E-07	1E-02	8E-09	2E-02
Landbay D	SRA 3	Debris Area	SRA3-TPC3-BASE1	3E-08	3E-02	2E-09	8E-02
Landbay D	SRA 3	Debris Area	SRA3-TPC3-SIDE2	1E-10	1E-02	3E-10	6E-02
Landbay D	SRA 4	Non-Debris Area	SRA3-TPC4-BASE1	6E-07	4E-02	4E-08	5E-02
Landbay D	SRA 4	Non-Debris Area	SRA3-TPC4-SIDE1	4E-07	3E-02	2E-08	2E-02
Landbay D	SRA 4	Non-Debris Area	SRA3-TPC4-SIDE2	3E-06	2E-01	2E-07	1E-01
Notes:							

1. Landbay Use Designation:
   - Landbay A - industrial/commercial use
   - Landbay B - mixed use
   - Landbay C - industrial/commercial use
   - Landbay D - residential use
   - Landbay E - residential use

3. No cumulative cancer risk and HI estimates are in excess of 1E-4 and 1, respectively.

4. Cumulative cancer risk and HI estimates are based on the highest concentration for each chemical at each location.

5. Cumulative cancer risk and HI estimates are calculated using site-related concentrations, which are those in excess of site-specific background for inorganics.

6. For location SRA1-TPA10-BASE2, the upper-bound HI estimate of 2 was refined using a 95% UCL on the mean calculated for PCBs and cobalt within a half-acre of this location; see results for SRA-1 on Table 3-3.

Table 3-6 - Soil and Concrete Waste Characterization Samples
ARC Gainesville, Gainesville, VA

Sample Collection Date	Field (Project) Sample ID	Lab Login/ Sample Group No.		Matrix	Location
NON-HAZARDOUS SOIL					
05/02/12	ARC-145686-SOILCHAR-001	L12050109	01/02	Soil	SRA 1 Stockpile
05/02/12	ARC-145686-SOILCHAR-002	L12050109	03/04	Soil	SRA 1 Stockpile
05/02/12	ARC-145686-SOILCHAR-003	L12050109	05/06	Soil	SRA 2A Stockpile
05/10/12	ARC-145686-SOILCHAR-004	L12050361	01/02	Soil	SRA 1 Stockpile
05/10/12	ARC-145686-SOILCHAR-005	L12050361	03/04	Soil	SRA 2A Stockpile
05/17/12	ARC-145686-SOILCHAR-008	L12050596	01/02	Soil	SRA 1 Stockpile
05/17/12	ARC-145686-SOILCHAR-009	L12050596	03/04	Soil	SRA 2A Stockpile
05/17/12	ARC-145686-SOILCHAR-010	L12050596	05/06	Soil	SRA 2A Stockpile
06/13/12	ARC-145686-SOILCHAR-010-1	L12060458	03	Soil	SRA 1/2A Stockpile [(1)]
06/28/12	ARC-145686-SOILCHAR-012	L12070022	03/04	Soil	SRA 2B Stockpile
09/25/12	ARC-145686-SOILCHAR-014	L12090721	01	Soil	SRA 7 stockpile
08/08/12	ARC-145686-SRA3	L12080278	01	Soil	SRA 3 Stockpile
TEST PITTING PROGRAM NON-HAZ SOIL					
09/25/12	ARC-145686-TestPit A	L12090721	2	Soil	Test Pit stockpile SRA 1
09/25/12	ARC-145686-TestPit C	L12090721	3	Soil	Test Pit stockpile SRA 3
02/14/13	ARC-145686-TPB-12	L13020466	1	Soil	Test Pit B-12
02/14/13	ARC-145686-TPB-12	L13020466	2	Soil	Test Pit B-12
02/14/13	ARC-145686-TPB-11	L13020466	3	Soil	Test Pit B-11
02/14/13	ARC-145686-TPB-11	L13020466	4	Soil	Test Pit B-11
02/14/13	ARC-145686-TPB-12A	L13020466	5	Soil	Test Pit B-12A
02/14/13	ARC-145686-TPB-12A	L13020466	6	Soil	Test Pit B-12A
02/14/13	ARC-145686SOILCHAR-015	L13020466	7	Soil	Test Pit Stockpile
02/14/13	ARC-145686SOILCHAR-015	L13020466	8	Soil	Test Pit Stockpile
02/14/13	ARC-145686SOILCHAR-016	L13020466	9	Soil	Test Pit Stockpile
02/14/13	ARC-145686SOILCHAR-016	L13020466	10	Soil	Test Pit Stockpile
NON-HAZARDOUS CONCRETE					
06/07/12	ARC-145686-43-conc	L12060255	01	Concrete	Bldg. 43 slab
06/13/12	ARC-145686-22-concrete	L12060458	04	Concrete	Bldg. 22 slab
06/13/12	ARC-145686-4-concrete	L12060458	05	Concrete	Bldg.4 slab
06/28/12	ARC-145686-15A-conc	L12070022	05	Concrete	Building 15A slab
06/28/12	ARC-145686-15-conc	L12070022	06	Concrete	Building 15 slab
09/25/12	ARC-145686-7-Conc	L12090722	01	Concrete	SRA 7 Building slab

[(1)] A composite sample of the SRA 1 and SRA 2A stockpiled soil represented by samples ARC-145686-SOILCHAR-008 through 010 was collected for TPH – GRO/DRO analysis, as one of the three separate samples exhibited an elevated level of TPH that had not been experienced in previous samples. After discussions with the disposal facility, it was determined that analysis of a composite sample for TPH – GRO/DRO would be prudent before accepting the material at the disposal facility. The resultant data supported disposal at Old Dominion.

Table 3-7 - Surface Water Samples
ARC Gainesville, Gainesville, VA

Date	Sample ID	Lab Login/ Sample Group #	Laboratory	Location of Sampled Water	Analyses Requested
1/22/2013	TPA 1020130122	6933179	Lancaster Labs	Test Pit 10	VOC's, PCB's, Cobalt, Manganese, Perchlorate
1/22/2013	TPA 1020130122-D	6933184	Lancaster Labs	Test Pit 10 dup	VOC's, PCB's, Cobalt, Manganese, Perchlorate
1/22/2013	TPA 1120130122	6933180	Lancaster Labs	Test Pit 11	VOC's, PCB's, Cobalt, Manganese, Perchlorate
1/22/2013	SRA 4 20130122	6933181	Lancaster Labs	SRA 4	VOC's, PCB's, Perchlorate
1/22/2013	SRA 7 20130122	6933182	Lancaster Labs	SRA 7	VOC's, Aluminum, Mercury
1/22/2013	Frac Tank 20130122	6933183	Lancaster Labs	Frac Tank	VOC's, PCB's, Aluminum, Cobalt, Iron Manganese, Perchlorate
2/28/2013	ARC-145686-SRA4-W	L13030019	Microbac Laboratories	SRA 4	Perchlorate, PCB's, Total VOC's and Total Metals

Figures

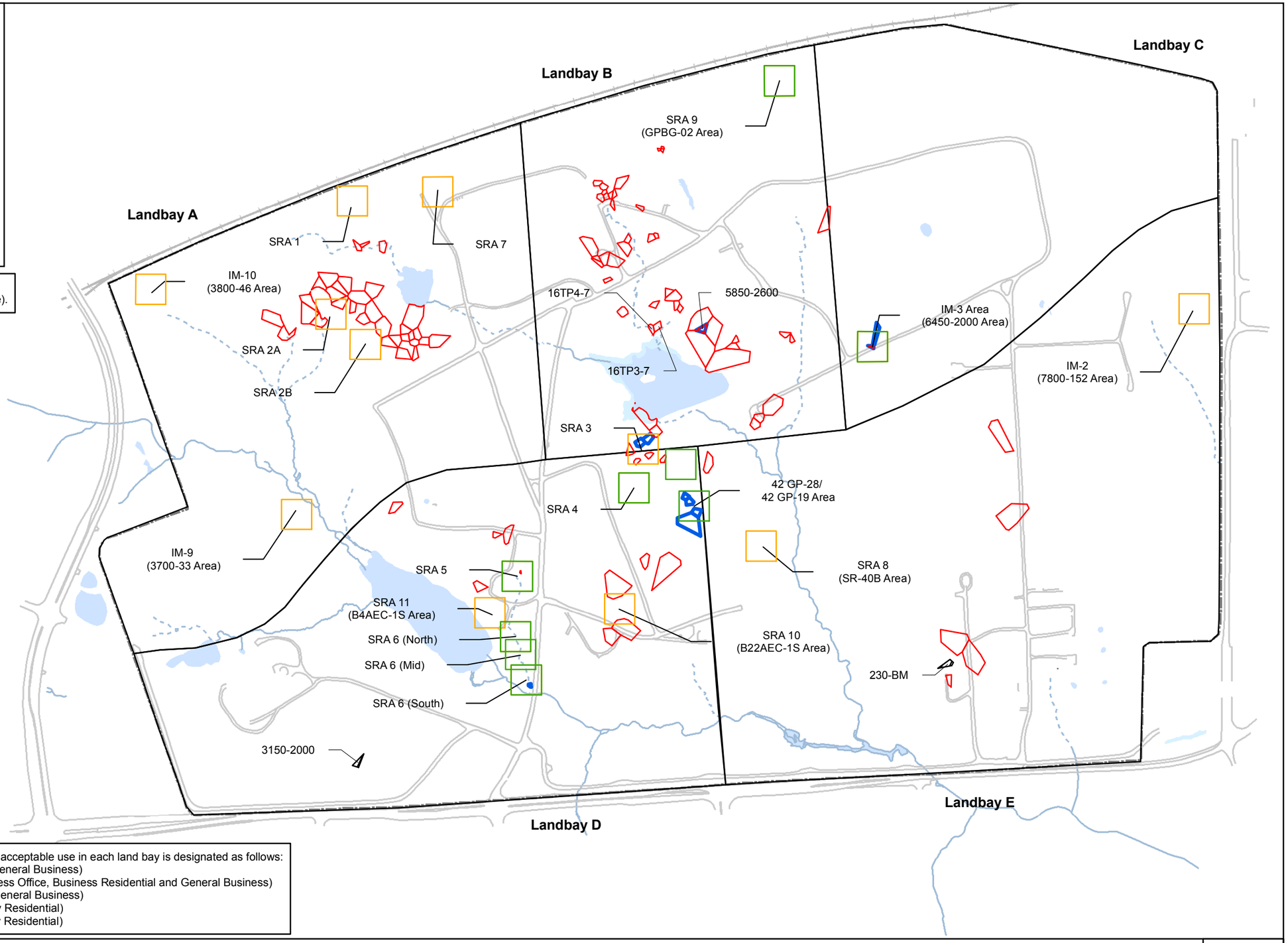
Exposure Areas:

- Soil IM Area
- Refinement Area
- Approximate Landbay Extent

Receptors with Potentially Unacceptable Risk Estimates

- Residential Direct Contact
- Residential Vapor Intrusion
- Homegrown Produce Exposure

Highlighted locations have refined cumulative cancer risks 10^{-4} or noncancer HIs above 1 for soil (assuming residential land use).



Notes:
1) This figure is based on Figure 4-1E from the November 2, 2012 RFI Baseline Risk Assessment (ENVIRON 2012).
2) Refined cumulative cancer risks and noncancer HIs are based on refined exposure concentrations (e.g, UCLs on the mean, mass limited, etc.) within each exposure area or maximum detected concentrations if adequate data are unavailable to support the refinement of exposure concentrations or if refinement is unnecessary.
4) There are no locations/areas with unacceptable risks or HIs for soil under industrial/commercial land use.

As described in Gainesville Associates' pending rezoning plan, acceptable use in each land bay is designated as follows:
Landbay A: Industrial/Commercial Use (Business Office and General Business)
Landbay B: Industrial/Commercial and Residential Use (Business Office, Business Residential and General Business)
Landbay C: Industrial/Commercial Use (Business Office and General Business)
Landbay D: Residential Use (Urban, High and Medium Density Residential)
Landbay E: Residential Use (Urban, High and Medium Density Residential)

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

POST-SOIL IM BASELINE RISK ASSESSMENT RESULTS FOR SOIL
ARC GAINESVILLE, VIRGINIA

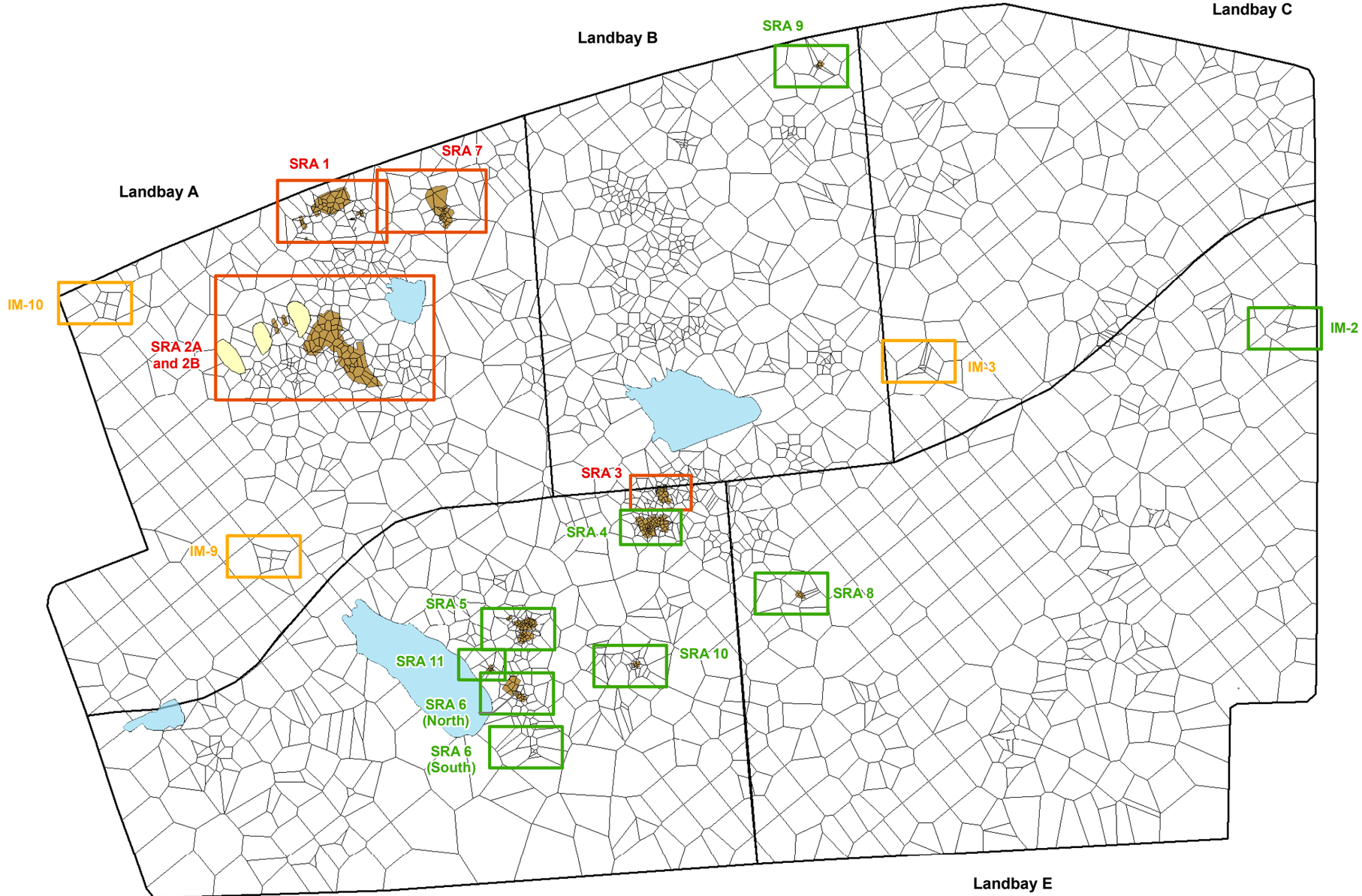
0 500
SCALE IN FEET

N E S W

Figure ES-1

Legend

- Soil Sub-Area Polygons
- Buried Debris Area
- Non-Debris Area
- Surface Debris Area
- TTU Excavation
- Soil IM Excavation Area 2013
- Large Ponds
- Approximate Landbay Extent



Note: The areas around the Thermal Treatment Unit (TTU), and large ponds were not included in the polygon tessellation conducted to establish the sub-areas.

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

SOIL SAMPLING LOCATIONS AND SOIL IM REMOVAL AREAS
ARC GAINESVILLE, VIRGINIA

0 500
SCALE IN FEET

N E S W

Figure 2-1

Soil Sample Location

Post-Excavation Confirmation Sampling Location

Test Pit Investigation

Soil IM Excavation Area 2013

Non-Debris Area

A6S152
42TP3-125
GP 43-01
42 GP-22
GP 42-03
DP-42
SRA3-BASE3
SRA3-TPC3-BASE1
SRA3-TPC3-SIDE2
SRA3-SIDE4
B42-2
42B135
42 GP-01
42 GP-24
TP-C3
A6G197
SRA3-TPC3-SIDE1
42TP3-175
GP 42-02
42G114
42G119
42TP5-75
B42-4
B42-3
TP-C6
42B133
42 GP-34
42 GP-03
42B134
TP-C9
TP-C5
TP-C7
42 GP-35
SRA 4
43G124
42 GP-33
43G113
43G127
TP-C8
SS-43A
42 GP-04
SRA4-33
SRA4-29
SRA4-37A
SRA4-32
SRA4-31
42 GP-25
SRA4-36
SRA3-TPC4-SIDE2
SRA4-27
SRA4-37
SRA4-17
SRA4-4
SRA4-26
SRA4-28
TP-C4
SRA4-30
SRA4-25
SRA4-35
SRA4-38
SRA4-5
42 GP-32
SRA3-TPC4-BASE1
SRA4-6
42 GP-16
SRA4-23
SRA4-3
SRA4-42
SRA4-18
SRA3-TPC4-SIDE1
SRA4-34
SRA4-16
SRA4-B4
SRA4-45
SRA4-42A
SRA4-9
SRA4-39
SRA4-14A
SRA4-10
42 GP-17
43G121
SRA4-24
43G122
SRA4-14
SRA4-44A
42 GP-26
43G128
43G130
SRA4-2
SRA4-40A
SRA4-13
SRA4-44
SRA4-46
SRA4-40
43B131
SRA4-43
SRA4-19
SRA4-11
SRA4-43A
SRA4-41A
SRA4-B2
SRA4-12
SRA4-1
SRA4-41
43B132
SRA4-B1
SRA4-20
SRA4-8
SRA4-22
SRA4-21
43G123
43G125
43G129

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

NON-DEBRIS AREA - SRA 4
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E S W

Figure 3-1A

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

NON-DEBRIS AREA - SRA 5
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E S W

Figure 3-1B

ENVIRON

DRAWN BY: HMN	DATE: 7/23/2013

NON-DEBRIS AREA - SRA 6 (NORTH)
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E S W

Figure 3-1C

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

NON-DEBRIS AREA - SRA 6 (SOUTH)
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E S W

Figure 3-1D

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

NON-DEBRIS AREA - SRA 8 (SR-40B AREA)
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E S W

Figure 3-1E

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

NON-DEBRIS AREA - SRA 9 (GPBG-02 AREA)
ARC GAINESVILLE, VIRGINIA

0 40
SCALE IN FEET

N E S W

Figure 3-1F

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

NON-DEBRIS AREA - SRA 10 (B22AEC-1S AREA)
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E S W

Figure 3-1G

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

NON-DEBRIS AREA - SRA 11 (B4AEC-1S AREA)
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E W S

Figure 3-1H

ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

NON-DEBRIS AREA - IM-3 (6450-2000 AREA)
ARC GAINESVILLE, VIRGINIA

0 40
SCALE IN FEET

N E W S

Figure 3-1I

ENVIRON

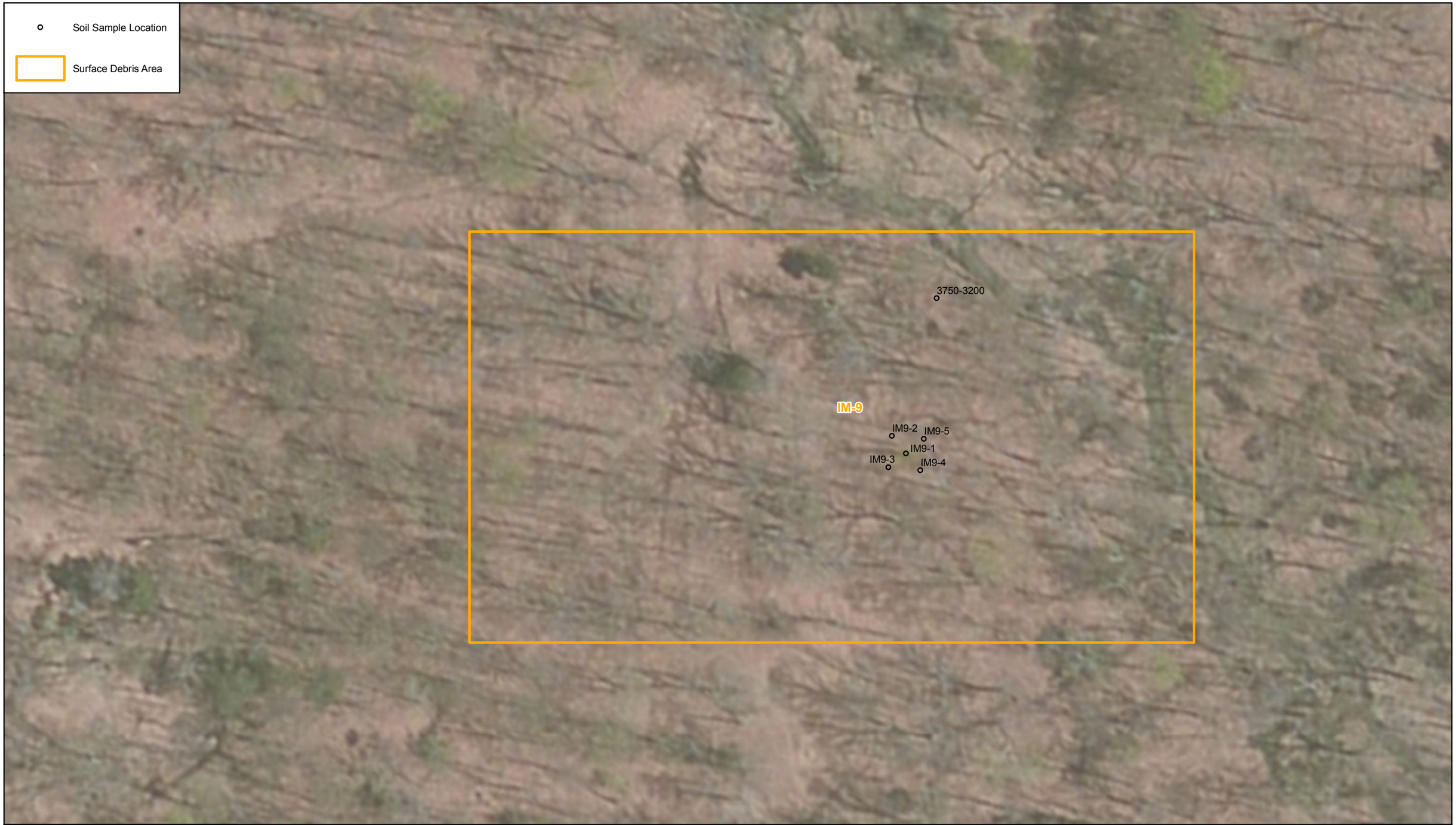
DRAWN BY: HMN | DATE: 7/23/2013

SURFACE DEBRIS AREA - IM-2 (7800-152 AREA)
ARC GAINESVILLE, VIRGINIA

0 40
SCALE IN FEET

N E S W

Figure 3-2A



ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

SURFACE DEBRIS AREA - IM-9 (3700-33 AREA)
ARC GAINESVILLE, VIRGINIA

0 40
SCALE IN FEET

N E S W

Figure 3-2B

ENVIRON

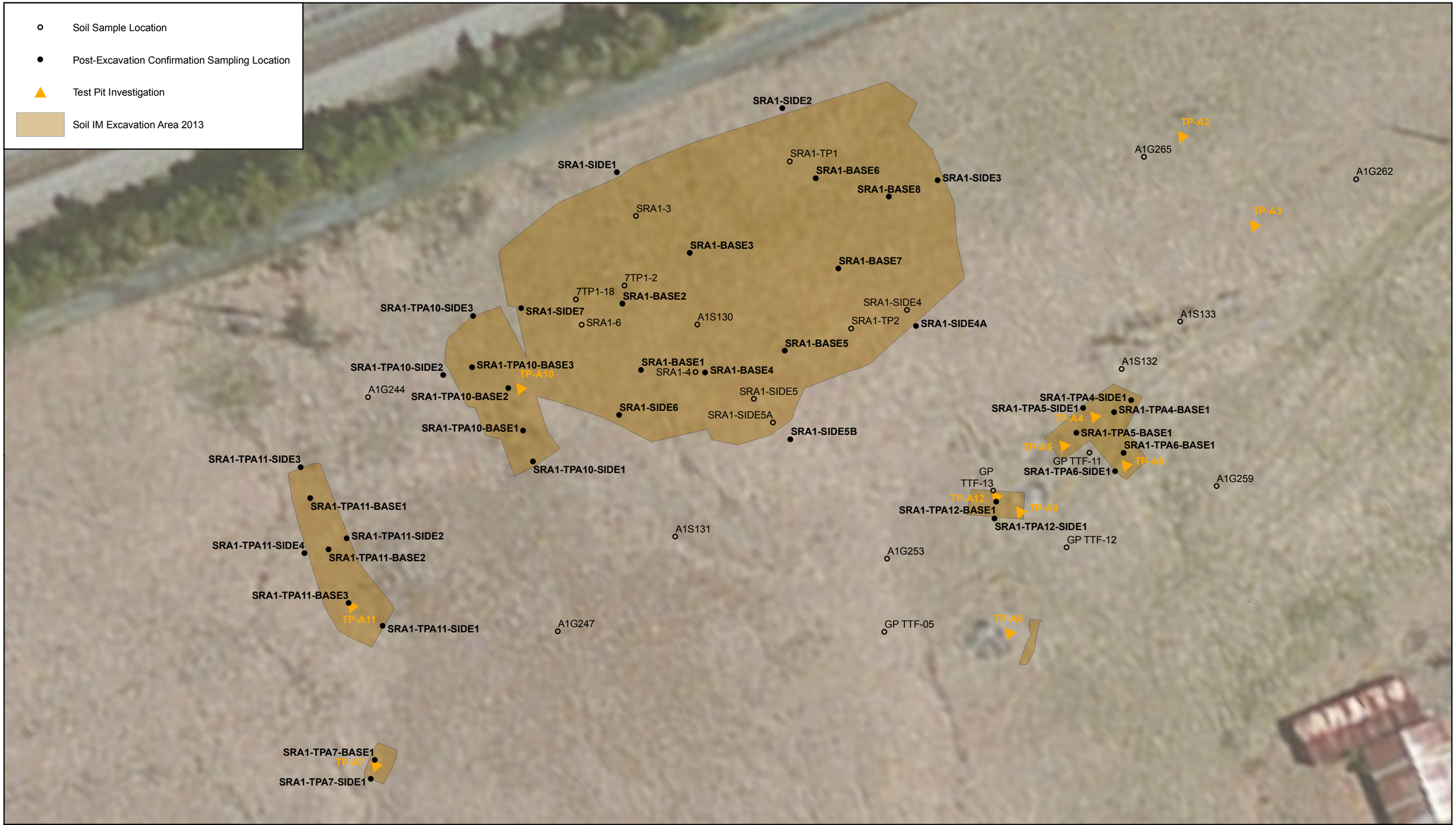
DRAWN BY: HMN | DATE: 7/23/2013

SURFACE DEBRIS AREA - IM-10 (3800-46 AREA)
ARC GAINESVILLE, VIRGINIA

0 40
SCALE IN FEET

N E S W

Figure 3-2C



ENVIRON

DRAWN BY: HMN | DATE: 7/23/2013

BURIED DEBRIS AREA - SRA 1
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E S W

Figure 3-3A

Soil Sample Location

Post-Excavation Confirmation Sampling Location

Test Pit Investigation

TTU Excavation

Soil IM Excavation Area 2013

TP-B20
TPB11-SIDE4
TP-B1
TP-B11
TP-B2
TPB12-SIDE4
TPB11-SIDE3
TPB11-SIDE1
TTU1P3-1
TPB12-SIDE1
TP-B12
TPB11-SIDE2
TTU2P2-10
TP-B7
A3G214
TPB12-SIDE3
TP-B10
TP-B19
TPB12-SIDE2
TP-B3
TP-B4
TP-B5
TTUP2-DS-1
SRA2A-BASE2
GP TTU-40
SRA2A-BASE1
SRA2A-SIDE8
TTU GP-33
GP TTU-42
TTU GP-31
SRA2A-SIDE1
GP TTU-43
SRA2A-SIDE9
TP-B13
SW TTU-03
A3B208
GP TTU-44
TTU GP-02
GP TTU-41
TTU GP-03
A3G226
TP-B8
SRA2-TPB8-BASE1
SRA2-TPB8-SIDE1
TP-B17
TP-B17-3
TP-B15-4
TP-B15
TP-B16
TP-B16-3
TP-B18
TP-B14
A3G235
TTU1P3-3
SRA2A-SIDE4
A2G202
SRA2A-SIDE5
SRA2A-BASE8
GP CM-15
SRA2A-BASE7
SRA2A-SIDE3
SRA2A-BASE4
SRA2A-SIDE6
GP TTU-39
TP-B9
TTU1P3-4
SRA2A-BASE5
SRA2A-SIDE7
SRA2A-BASE3
SRA2A-BASE6
SRA2A-SIDE2
GP CM-14
A3S145
SRA2B-SIDE1
GP 105-14
A3S144
SRA2B-BASE1
106 TP-6
SRA2B-SIDE10
SRA2B-SIDE2
GP 105-13
GP 105-09
SRA2B-BASE2
SRA2B-BASE3
GP 105-06
GP 105-15
SW CM-08
GP 105-11
SRA2B-SIDE3
SRA2-TPB8-BASE1
106TP3-7
A3S146
SRA2B-BASE5
106 TP-5
GP 105-12
105G42
106TP2-28
SRA2B-BASE4
SRA2B-SIDE9
106TP4-7
GP 105-10
106TP1-7
106TP2-20
SRA2B-BASE6
SRA2B-SIDE4
A3S147
105G43
GP 105-07
SRA2B-BASE7
105G41
SRA2B-SIDE8
106 TP-7
SRA2B-BASE8
SRA2B-SIDE5
SRA2B-SIDE7
SRA2B-SIDE6
105G44

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BURIED DEBRIS AREA - SRA 2A and 2B

ARC GAINESVILLE, VIRGINIA

0 60

SCALE IN FEET

N E S W

Figure 3-3B

Soil Sample Location

Post-Excavation Confirmation Sampling Location

Test Pit Investigation

Soil IM Excavation Area 2013

Buried Debris Area

A8S154
TP-C1
42TP6-5
42TP4-125
42TP4-136
42TP4-127
A6S158
A8S170
42TP6-40
42G115
42G117
42TP3-25
42TP4-75
TP-C2
42B136
42TP3-37
42TP6-75
GP 42-04
SRA3-SIDE2
42TP3-43
A6S157
42TP3-54
42TP4-30
SRA3-SIDE3
A6S153
SRA3-BASE1
42TP3-75
42TP4-6
42TP4-9
SRA3-BASE2
B42-1
SB 43-01
42 GP-23
42TP4-(-5)
SRA3-BASE4
SRA 3
SRA3-SIDE1
42G118
42G120
GP 43-01
A6S152
42TP3-125
GP 42-03
DP-42
42 GP-22
SRA3-BASE3
SRA3-TPC3-BASE1
SRA3-TPC3-SIDE2
SRA3-SIDE4
B42-2
42B135
42 GP-01
42 GP-24
TP-C3
SRA3-TPC3-SIDE1
A6G197
42TP3-175
GP 42-02
42G114
42G119
42TP5-75
B42-4
B42-3
TP-C6
42B133
42 GP-34
42 GP-03
42B134
TP-C9
TP-C5
TP-C7
42 GP-35
42 GP-33
43G124
43G127
43G113
TP-C8
SS-43A
42 GP-04
SRA4-33
SRA4-29
SRA4-37A
SRA4-32
SRA4-31
42 GP-25
SRA4-27
SRA4-36
SRA4-37
SRA3-TPC4-SIDE2
SRA4-17
SRA4-4
SRA4-26
SRA4-28
TP-C4
SRA4-35
SRA4-38
SRA4-30
SRA4-25
SRA4-5
42 GP-32
SRA4-6
42 GP-16
SRA3-TPC4-BASE1

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BURIED DEBRIS AREA - SRA 3
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E S W

Figure 3-3C

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BURIED DEBRIS AREA - SRA 7
ARC GAINESVILLE, VIRGINIA

0 30
SCALE IN FEET

N E S W

Figure 3-3D

Soil Sample Location

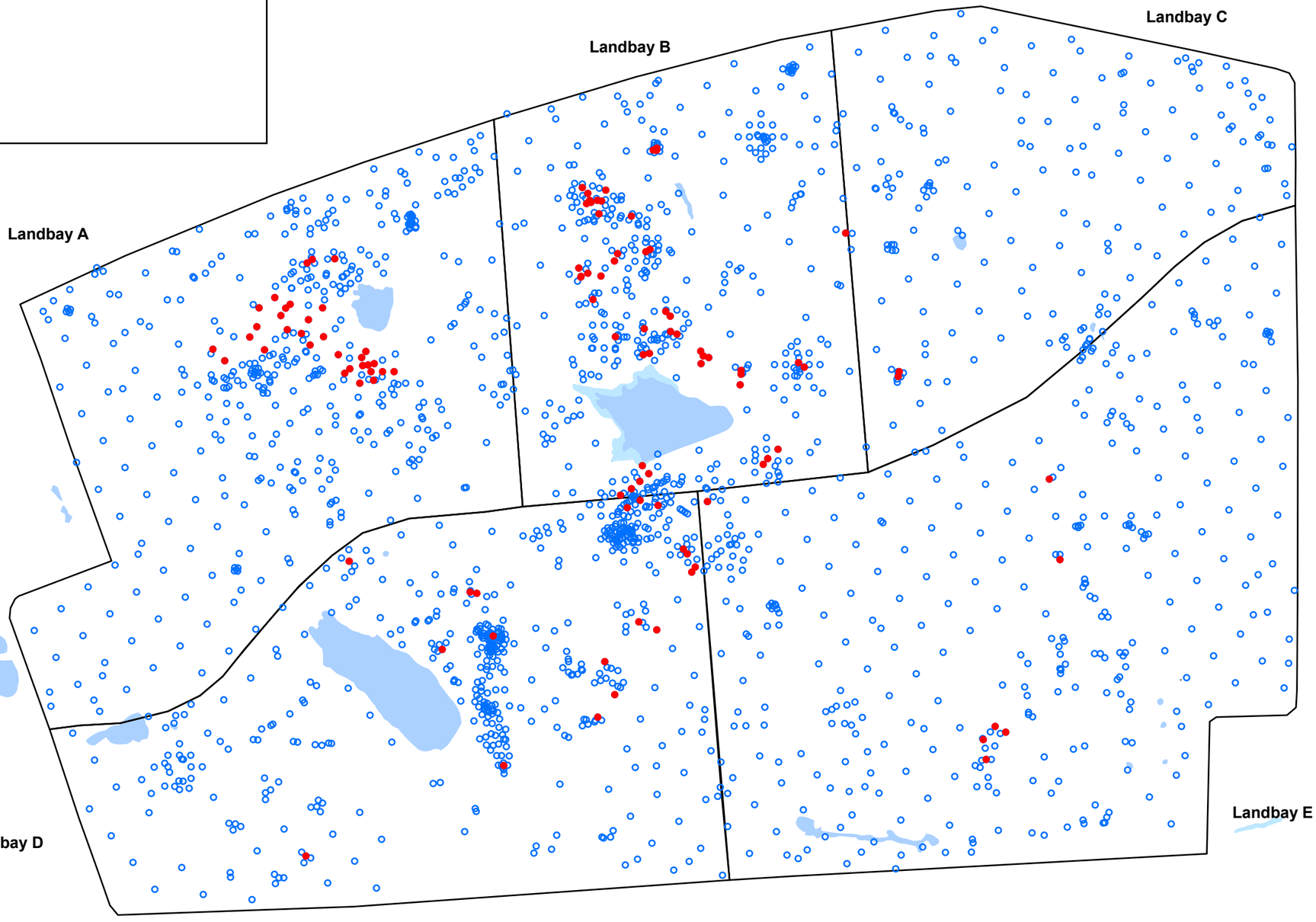
Locations With Refined Site-Related Cumulative Cancer Risks Above 10^{-4} Or Noncancer His For Soil

Approximate Landbay Extent

Wetland

Pond

Highlighted locations have refined cumulative cancer risks 10^{-4} or noncancer HIs above 1 for soil (assuming residential land use).



Note: The areas around the Thermal Treatment Unit (TTU) and large ponds were not included in the polygon tessellation conducted to establish the sub-areas.

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POST-SOIL IM BASELINE RISK ASSESSMENT RESULTS FOR SOIL – SOIL SAMPLING LOCATIONS ARC GAINESVILLE, VIRGINIA

0 500

SCALE IN FEET

N E S W

Figure 4-1

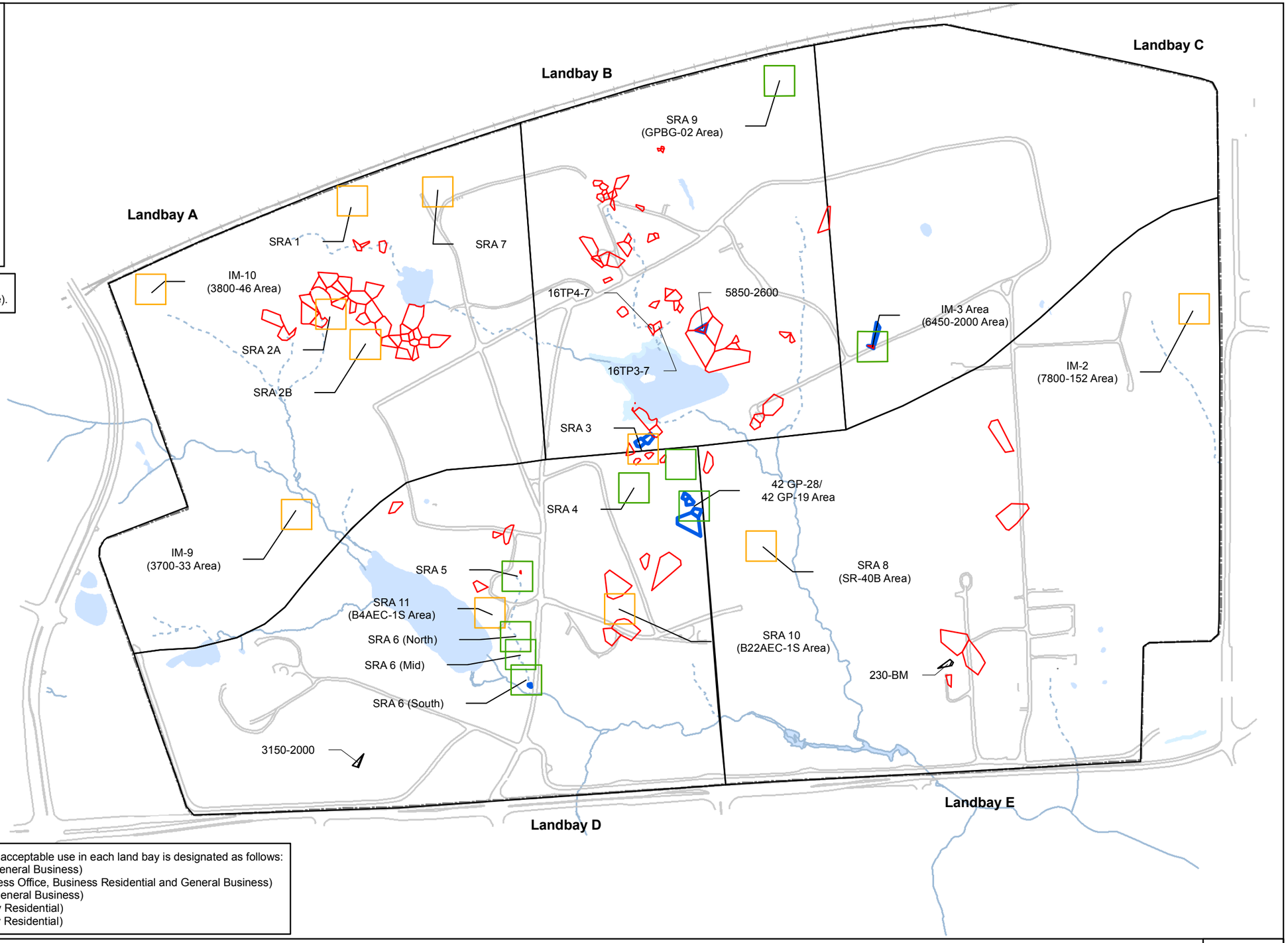
Exposure Areas:

- Soil IM Area
- Refinement Area
- Approximate Landbay Extent

Receptors with Potentially Unacceptable Risk Estimates

- Residential Direct Contact
- Residential Vapor Intrusion
- Homegrown Produce Exposure

Highlighted locations have refined cumulative cancer risks 10^{-4} or noncancer HIs above 1 for soil (assuming residential land use).



Notes:
1) This figure is based on Figure 4-1E from the November 2, 2012 RFI Baseline Risk Assessment (ENVIRON 2012).
2) Refined cumulative cancer risks and noncancer HIs are based on refined exposure concentrations (e.g, UCLs on the mean, mass limited, etc.) within each exposure area or maximum detected concentrations if adequate data are unavailable to support the refinement of exposure concentrations or if refinement is unnecessary.
4) There are no locations/areas with unacceptable risks or HIs for soil under industrial/commercial land use.

As described in Gainesville Associates' pending rezoning plan, acceptable use in each land bay is designated as follows:
Landbay A: Industrial/Commercial Use (Business Office and General Business)
Landbay B: Industrial/Commercial and Residential Use (Business Office, Business Residential and General Business)
Landbay C: Industrial/Commercial Use (Business Office and General Business)
Landbay D: Residential Use (Urban, High and Medium Density Residential)
Landbay E: Residential Use (Urban, High and Medium Density Residential)

ENVIRON

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POST-SOIL IM BASELINE RISK ASSESSMENT RESULTS FOR SOIL
ARC GAINESVILLE, VIRGINIA

0 500
SCALE IN FEET

N E S W

Figure 4-2

Appendices